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FILM ARTIFACT DIAGNOSTICS GUIDE for *Kodak X-Omat* Automatic Film Processors



HEALTH IMAGING

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Learning What to Look for When Identifying Artifacts

Definition of Artifacts

Artifacts are defects on the processed film.

Examining Films for Artifacts

It is important to check films regularly for artifacts. By checking films for artifacts as part of your daily routine, you are better able to identify and eliminate the source of artifacts as soon as the problem arises. The early detection of artifacts can help you reduce the number of films that are affected by unwanted artifacts. This in turn provides two benefits:

1. lowered operating costs
2. minimized patient exposure to x-rays

You can incorporate the simple task of checking for film artifacts into your daily routine by following the two guidelines outlined below.

1. Check for film artifacts before and after you perform any of the procedures listed below:
 - Preventive Maintenance Checks
 - Cleaning of the Racks
 - Inspection of Components and Assemblies
2. Check for artifacts on films as they exit the processor. When examining films for artifacts, try to do the following steps:
 - Isolate the artifact.
 - Identify the cause of the artifact immediately.
 - Make any necessary corrections to eliminate the cause.

Impact of Lighting Conditions

Another important factor to keep in mind when you examine artifacts is the lighting conditions under which you are examining the films. Different lighting conditions can help you identify different types of artifacts.

For example, by using reflected light, you will be able to locate flaws in the surface quality of a film more quickly and easily than if you use transmitted light. Therefore, if you are particularly interested in looking for unusual drying patterns or artifacts caused in the wash stage of the processing cycle, you should examine your films with reflected light.

If on the other hand, you wish to uncover artifacts caused in the development stage of the processing cycle, you should use transmitted light when examining the films. Transmitted light will enable you to see "through" the film rather than just being able to see the surface. To examine films, use an appropriate viewbox in a darkened room. Mask the area around the film so that extraneous light from the viewbox does not affect your viewing.

Determining the Cause of Artifacts

When examining artifacts, watch for the indications listed below that may help you determine the cause of the artifact:

- characteristics of the film
- characteristics of the artifact
- position of the artifact

Film Characteristics

Identifying the characteristics of the film can help you trace the cause of the artifact. For example, noting where the artifact appears on the sheet of film in reference to the items listed below can help you identify which parts in the processor might be causing the artifact.

- the direction of film travel
 - leading edge
 - trailing edge
- the film emulsion
 - single emulsion fed up
 - single emulsion fed down
 - double emulsion

Density Characteristics

The density of the artifact can also help you determine the cause of the artifact. Determining whether the artifacts are plus density (darker than the background) or minus density (lighter than the background) can provide you with useful information to determine in which stage of the processing cycle the artifact appeared.

Plus-density (dark) artifacts can indicate one of two different scenarios:

1. The artifact was caused by the application of physical pressure to the film after the film was exposed.
 - poor film-handling techniques unloading the film from a Cassette
 - dropping or bending the film before feeding it into the processor
2. The artifact was caused sometime during the development stage of the processing cycle.

Minus-density (light) artifacts can indicate one of three different scenarios:

1. The artifact was caused by the application of physical pressure to the film before the film was exposed.
 - poor film handling techniques before or during the loading of the film into a Cassette
2. The artifact was caused sometime during the fixing or washing stage of the processing cycle.
3. The artifact was caused by dust or dirt in the Cassette.

Artifact Position

The position of the artifact on the film with relation to the direction of film travel can also provide you with helpful information in determining what caused the artifact.

The spacing between artifacts can also serve as a valuable clue in diagnosing artifacts. For example, if artifacts appear 79.8 mm (3.14 or π inches) apart and are parallel to the leading edge of the film, the artifacts are probably caused by a problem with a Roller. If the artifacts are spaced identically to the spacing between the Tips of a Guide Shoe, the cause of the artifact is probably a Guide Shoe.

Checking for Artifacts

Introduction

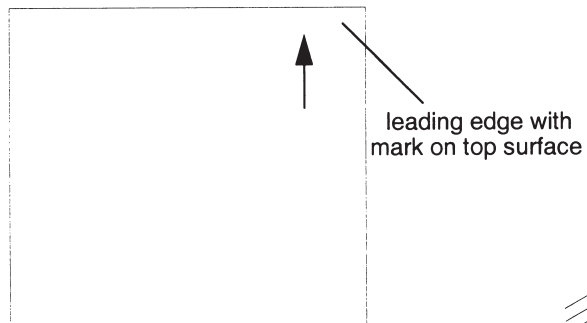
To begin diagnosing the cause of an artifact, you must first answer two basic questions:

1. Which is the leading edge of the film?
2. Do the artifacts appear on the top or the bottom surface of the film?

Identifying the Leading Edge

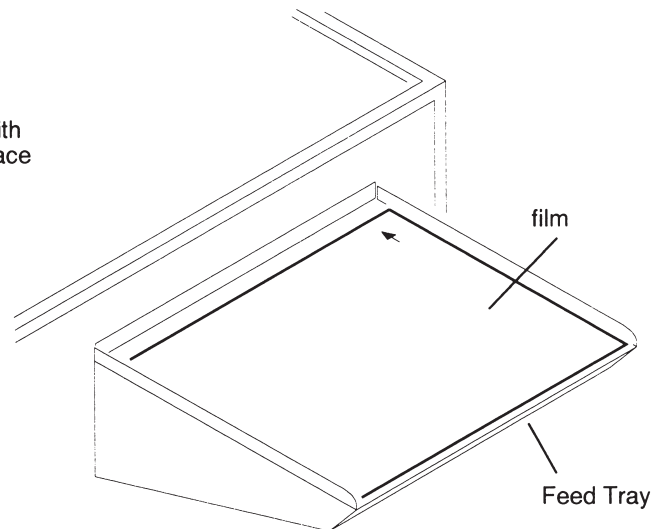
The leading edge of a sheet of film is the edge of the film that is fed first into the Entrance Rollers of the processor. As well as being the first edge fed into the processor, the leading edge is also the first edge to exit from the Exit Slot in the Dryer. Once you have removed a processed sheet of film from the Receiving Bin of the processor, it may be difficult to remember which end is the leading edge of the film. Without knowing which end is the leading edge of film, it also becomes difficult to identify which edge of the film was on the drive side of the processor and which edge was on the non-drive side of the processor. To help you find the leading edge of the film, inscribe or scratch an arrow on the right corner of the top emulsion on the leading edge of the film before you feed the film into the processor.

Figure 1 Identifying the Leading Edge



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Figure 2 Feeding a Sheet of Film

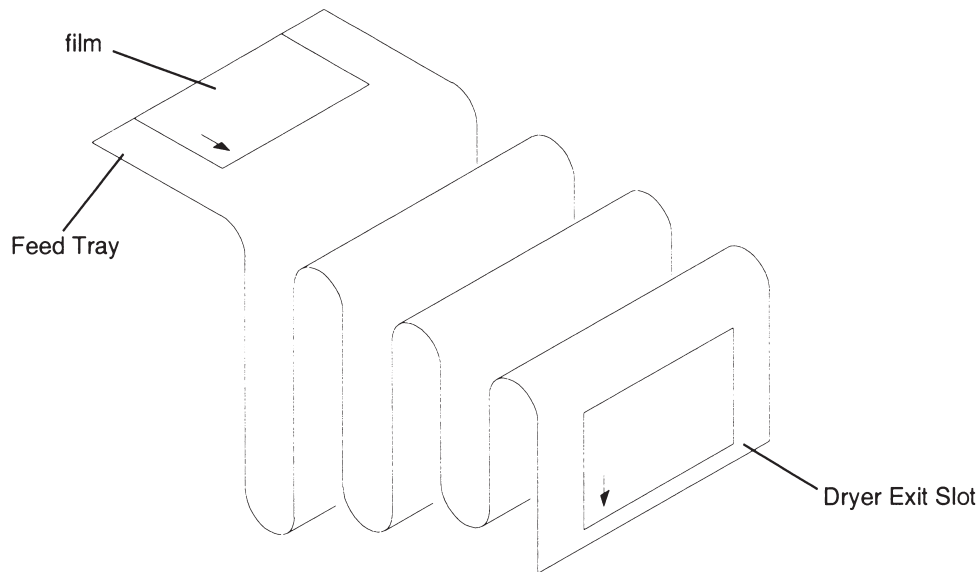


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Identifying the Top Surface

The top surface of the film is the surface that faces up as you feed the film into the processor. Once you have removed a processed sheet of film from the Receiving Bin of the processor, it may be difficult to remember which side was facing up as you fed the film into processor. If you drew an arrow at the right corner on the leading edge of the film, that same arrow can help you identify the top surface of the film.

Figure 3 Identifying the Top Surface of the Film



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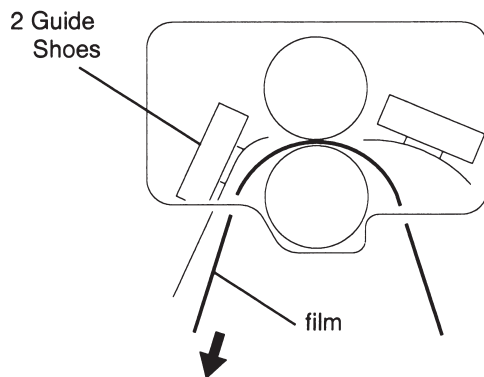
Identifying Artifacts Caused by Components of the Processor

Artifacts Caused by Guide Shoes

Several components of the processor, such as the Guide Shoes located in the Crossover Assemblies and in the Turnaround Assemblies, can potentially cause film artifacts, especially if the components are worn or are not adjusted correctly.

Guide Shoes in Crossover Assemblies

Figure 4 Identifying Guide Shoes in the Crossover Assemblies

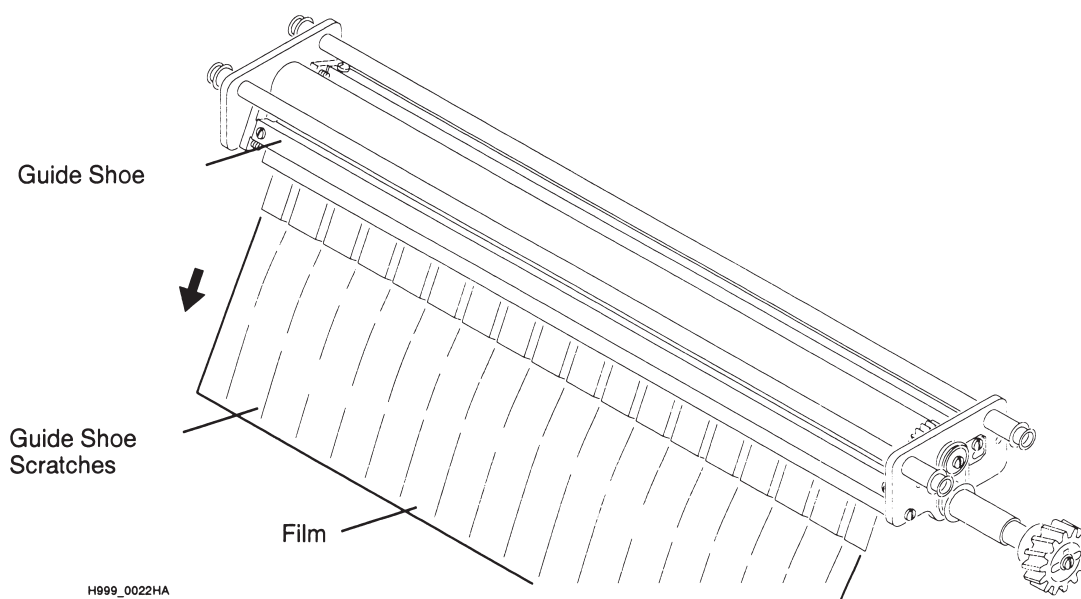


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If the Guide Shoes in the Crossover Assemblies are not correctly installed, the Guide Shoes can potentially scratch or mark the top surface of the film. Guide Shoe Marks can appear as either plus or minus density scratches. Guide Shoe Marks are typically easy to identify because they appear at regular intervals.

- Guide Shoe Marks caused by ribbed Guide Shoes appear at 25.4 mm (1 inch) or a multiple of 25.4 mm (1-inch) intervals.
- Marks caused by textured Guide Shoes appear at 0.06 mm (1/16 inch) or a multiple of 0.06 mm (1/16-inch) intervals.

Figure 5 Identifying Scratches Caused by Guide Shoes in the Crossover Assemblies



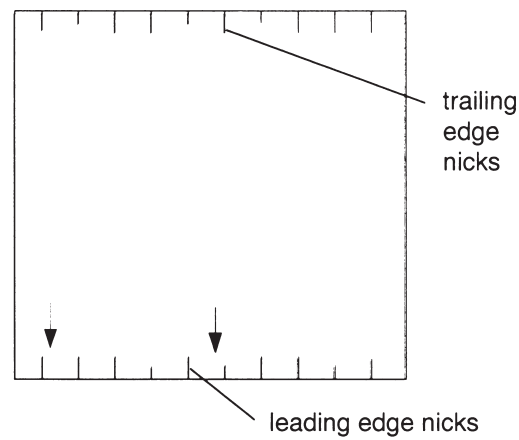
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During normal operation of the processor, the film travels through several assemblies that contain Guide Shoes. As the film enters any one of the Crossover, Turnaround, or Squeegee Assemblies, the film responds in the same way.

- The leading edge of the film contacts the Guide Shoes.
- The remainder of the film conforms to the shape of the Master Roller.
- The trailing edge of the film "snaps" against the Guide Shoe as it exits the Assembly.

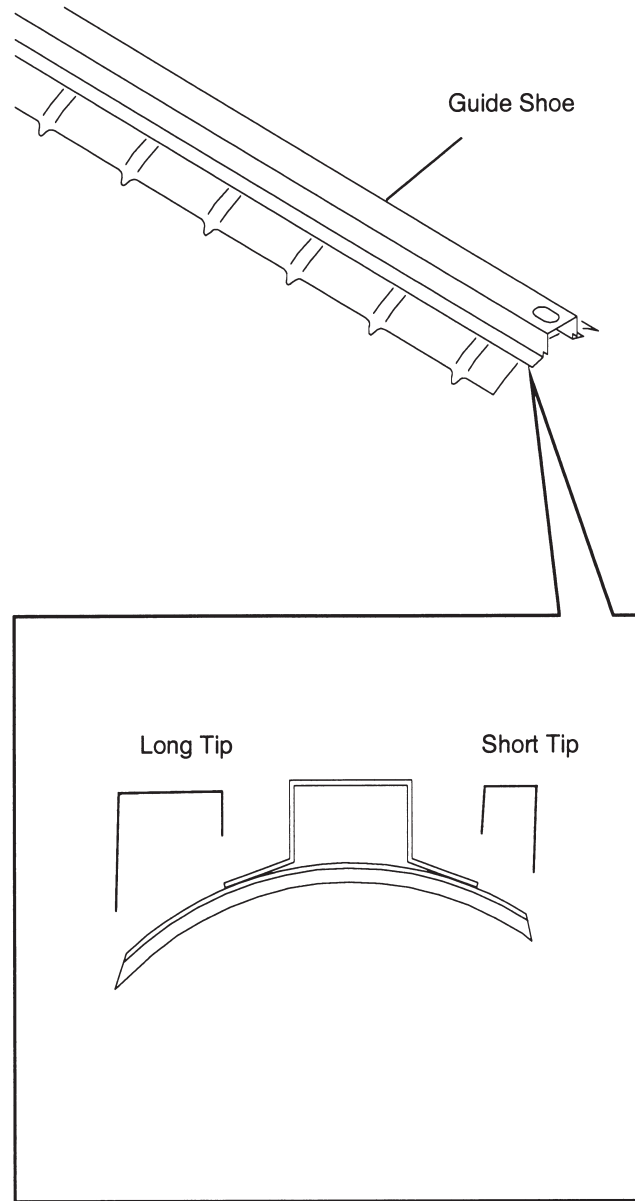
As a result of their contact with the Guide Shoes, both the leading and trailing edges of the film may acquire artifacts. Most often the artifacts appear as nicks measuring up to, but not exceeding, 0.3 mm (1/4 inch). The position of the nicks on the film will directly correspond to the location of the Tips on the Guide Shoes.

Figure 6 Matching the Nicks to the Tips of the Guide Shoes



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Figure 7 Identifying Nicks Caused by Guide Shoes

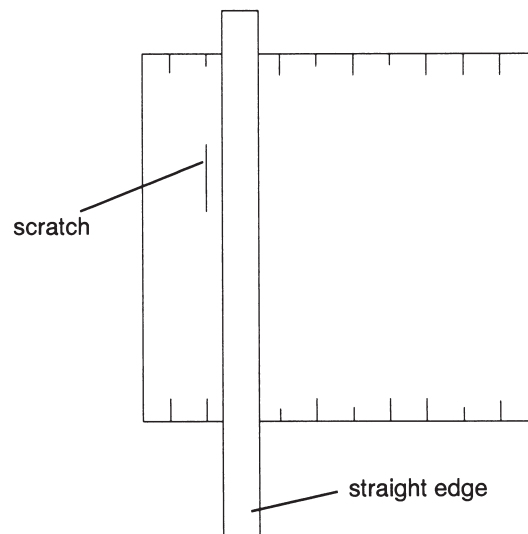


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The position of Guide Shoe nicks can help you determine where a single scratch or mark is originating. When you encounter a single scratch or mark on a film, use the steps below to help you determine whether a Guide Shoe was the cause of the artifact.

1. Using a straight edge, align the nicks on the leading edge and the trailing edge of the film that are closest to the scratch or mark.
2. Check whether the scratch or mark artifact appearing on the film lines up with the straight edge.
 - If the scratch or mark artifact aligns with the straight edge and the two nicks, then the scratch or mark is most likely caused by a Guide Shoe.

Figure 8 Testing for Guide Shoe Artifacts



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Guide Shoes in Turnaround Assemblies

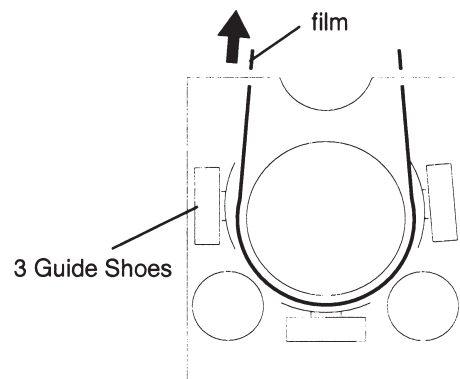
If the Guide Shoes are not correctly installed in the Turnaround Assemblies, the Guide Shoes can potentially scratch or mark the bottom surface of the film. Worn Roller Bearings can also contribute to unwanted scratches and marks on the film. When the components of the Rollers wear, they can sometimes drive the film off the normal path and cause the film to contact the Guide Shoes, thus causing scratches on the film.

Just like scratches or marks caused by Guide Shoes in the Crossover Assemblies, scratches or marks caused by Guide Shoes in the Turnaround Assemblies are typically easy to identify because they appear at regular intervals.

- Guide Shoe Marks caused by ribbed Guide Shoes appear at 25.4 mm (1 inch) or a multiple of 25.4 mm (1-inch) intervals.
- Marks caused by textured Guide Shoes appear at 0.06 mm (1/16 inch) or a multiple of 0.06 mm (1/16-inch) intervals.

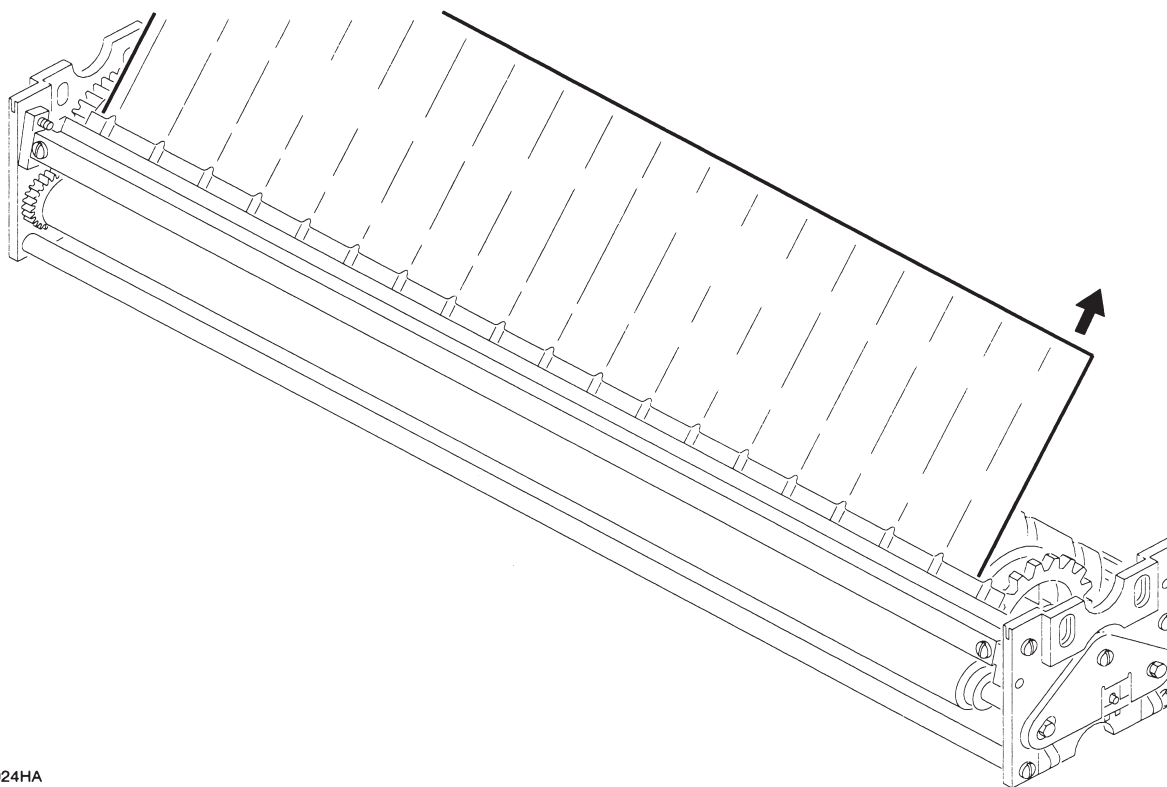
Scratches or marks caused by Guide Shoes possess one other identifying characteristic. The scratches or marks are parallel to the direction of the film travel.

Figure 9 Identifying Guide Shoes in the Turnaround Assemblies



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Figure 10 Identifying Scratches Caused by Guide Shoes in the Turnaround Assemblies



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Artifacts Caused by Rollers

The Rollers in the outside path of the Developer, Fixer, or Wash Rack contact the bottom surface of the film. Any scratches or marks caused by the Outer Path Rollers occur on the bottom surface of the film.

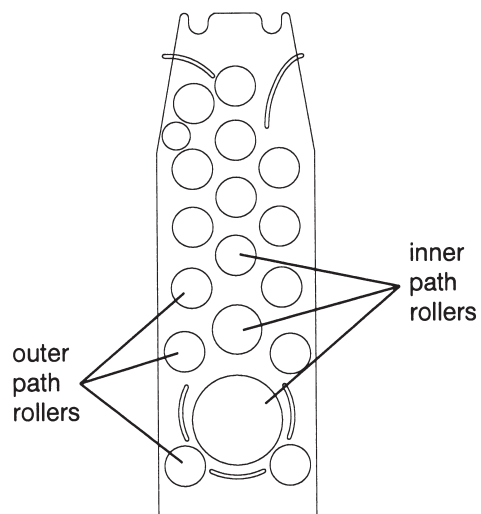
The Rollers in the inside path of the Developer, Fixer, or Wash Rack contact the top surface of the film. Any scratches or marks caused by the Inner Path Rollers occur on the top surface of the film.

Scratches or marks caused by the Outer and the Inner Path Rollers are similar in that they both possess one main identifying characteristic:

- The scratches or marks on the film are spaced at approximately the same distance as the circumference of a Roller.

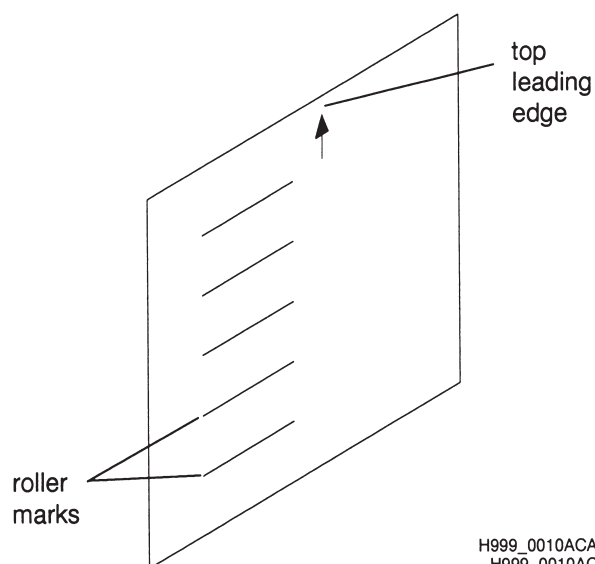
Diameter of the Roller	Circumference of the Roller $\pi \times \text{Diameter}$	Space Between Artifacts
25.4 mm (1 inch)	79.8 mm (3.14 inches)	79.8 mm (3.14 inches)
50.0 mm (2 inches)	159.5 mm (6.28 inches)	159.5 mm (6.28 inches)

Figure 11 Identifying Inner and Outer Path Rollers



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Figure 12 Identifying Artifacts Caused by Inner and Outer Path Rollers



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Diagnostic Procedures

Purpose

In the procedures that follow, you will isolate the origin of the artifact. First you will determine whether the artifact may be caused by the film itself, by poor film handling before the film is processed, or by a component in the processor. Then, if you determine that the artifact is caused during the processing of the film, you will determine which component most likely caused the artifact by systematically ruling out one component at a time as the origin.

The diagnostic procedures will be most helpful to you in determining the cause of artifacts that consistently appear either parallel or perpendicular to the leading edge of film. The procedures will not be as helpful in determining the origin of random artifacts. By using the diagnostic procedures, you may be able to determine which particular assembly caused the random artifact.

Important:

- When doing the following procedures, use a new sheet of pre-exposed, unprocessed film for each procedure.
- Generally when you perform this procedure it is best to use a film size that is as wide as the film path through the processor. Throughout the examples that follow, the film size referenced will be 35 x 43 cm (14 x 17 inch).
- When diagnosing artifacts that appear on mammography film, it is best to use the largest size mammography film you have available when performing the diagnostic procedures that follow.
- Perform all diagnostic procedures in a darkroom with appropriate safelight conditions.

The procedures will have you remove each of the Crossover Assemblies in turn, and manually insert the film into each of the Racks. If an artifact disappears when you manually feed the film into a given Rack, then it is most likely the Crossover causing the artifact.

You will also rotate the film 90 degrees each time you manually feed the sheet of film into a new processing solution. By rotating the film, you change the leading edge of film that is fed. By using the 43 cm (17-inch) edge as the leading edge through the developer section, and using the 35 cm (14-inch) edge as the leading edge through the fixer solution, you can determine important facts about the artifacts:

- whether the artifact can be classified as one that consistently appears parallel or perpendicular to the leading edge, or one that is random
- which rack component most likely caused the artifact if the artifact consistently appears parallel or perpendicular to the leading edge

Once you have determined which assembly is causing the artifact, check the assembly for worn or damaged parts. If necessary, install new parts on the assembly.

Determining Whether the Artifact Was Caused During the Processing of the Film

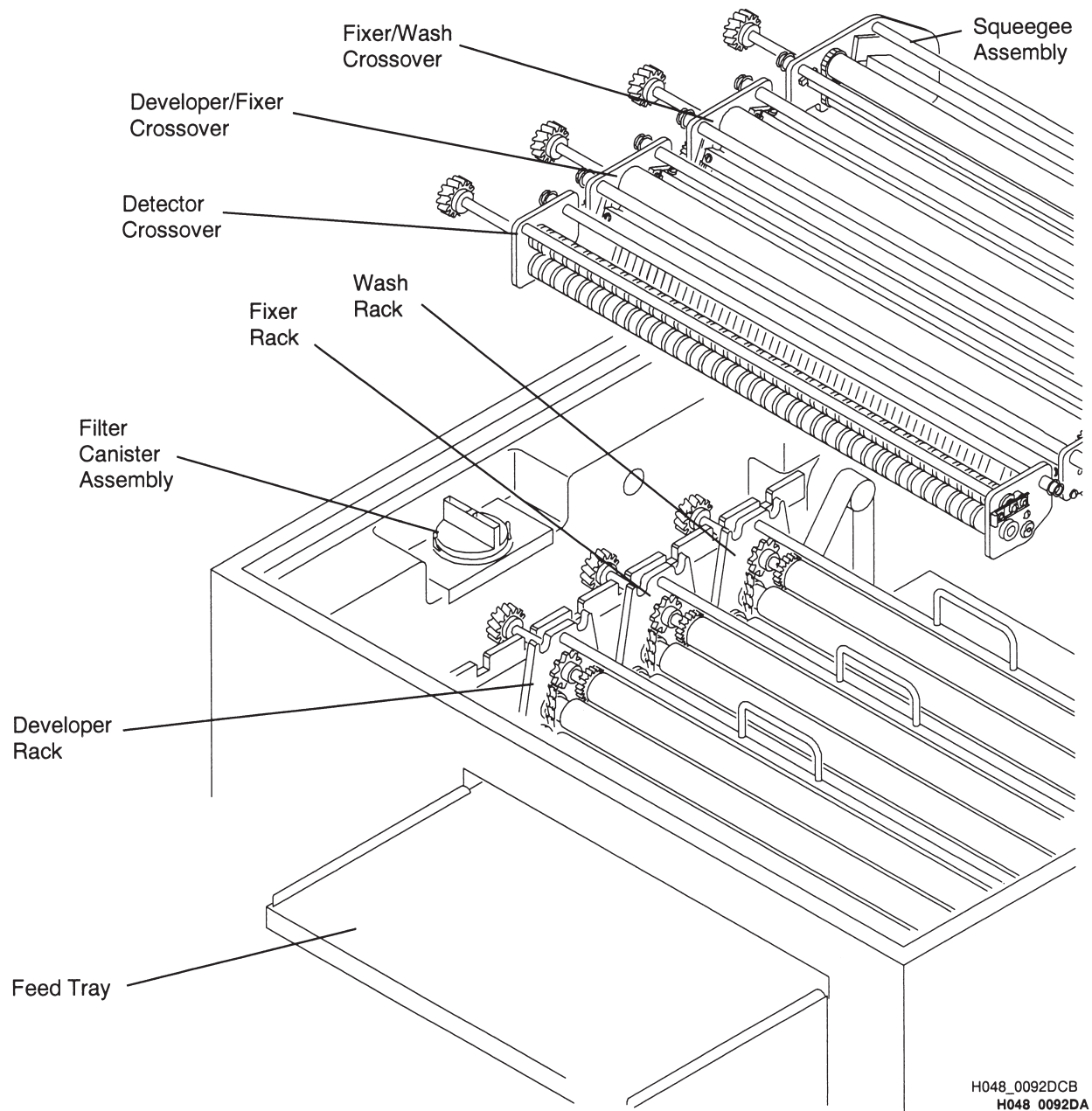
Occasionally, an entire box of film may be dropped or handled carelessly before the films are exposed or processed. Poor film handling can result in the appearance of consistent artifacts on multiple sheets of processed film. To determine whether artifacts are the result of poor film handling or are caused during the processing of the film, do the steps below.

1. Feed a pre-exposed, unprocessed sheet of 35 x 43 cm (14 x 17 inch) film so that the 43 cm (17-inch) edge of the film enters the Detector Crossover Assembly first.
2. Allow the film to complete the normal processing cycle.
3. Feed a second sheet of pre-exposed, unprocessed 35 x 43 cm (14 x 17 inch) film, but this time rotate the film 90 degrees so that the 35 cm (14-inch) edge of the film enters the Detector Crossover Assembly first.
4. Allow the film to complete the normal processing cycle.
5. Compare the artifacts on the two sheets of film.
 - If the artifact rotated, then you can eliminate the processor as the cause of the artifact. The artifact is due most likely to poor film-handling practices.
 - If the artifact did not rotate, continue with the procedures that follow to determine which component in the processor caused the artifact.

Isolating the Individual Processor Components

Use the figure below to help you identify the individual components of the processor.

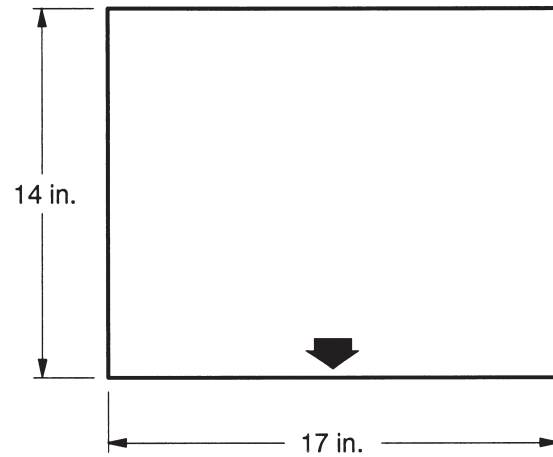
Figure 13 Identifying the Components of the Processor



Isolating the Detector Crossover Assembly

1. Remove the Detector Crossover Assembly.
2. Manually feed a pre-exposed, unprocessed sheet of 35 x 43 cm (14 x 17 inch) film so that the 43 cm (17-inch) edge of the film enters the Developer Rack first.

Figure 14 Feeding Film Correctly



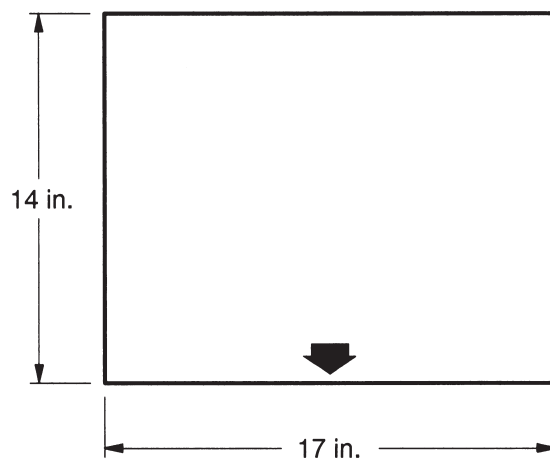
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3. Allow the film to complete the normal processing cycle.
4. Install the Detector Crossover Assembly.
5. Check the film for artifacts.
 - If the artifact you are diagnosing does not appear, then the Detector Crossover Assembly is most likely the cause of the artifact.
 - If the artifact does appear, continue with the next procedure.

Isolating the Developer/Fixer Crossover Assembly

1. Remove the Developer/Fixer Crossover Assembly.
2. Feed a pre-exposed, unprocessed sheet of 35 x 43 cm (14 x 17 inch) film so that the 43 cm (17-inch) edge of the film enters Detector Crossover Assembly first.

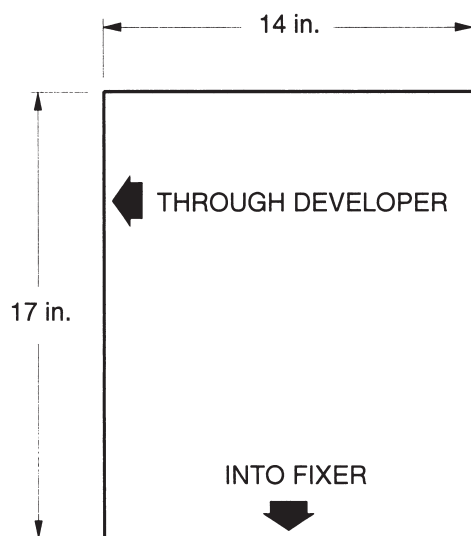
Figure 15 Feeding Film Correctly



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3. Remove the film as it exits from the Developer Rack.
4. Rotate the film 90 degrees.
5. Manually feed the film into the Fixer Rack so that the 35 cm (14-inch) edge of the film enters the Fixer Rack first.

Figure 16 Manually Feeding the Film into the Fixer Rack



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6. Allow the film to complete the normal processing cycle.

7. Check the film for artifacts.
 - If the artifact you are diagnosing does not appear, then the Developer/Fixer Crossover Assembly is most likely the cause of the artifact.
8. Compare the sheet of film that just exited the processor with the original film displaying the artifact.
 - If the position of the artifact on the two sheets of film is the same, then the artifact most likely occurred before you rotated the film and therefore was caused in the developer section of the processor.
 - If the position of the artifact on the two sheets of film is different by 90 degrees, then the artifact most likely occurred after you rotated the film. The artifact may then have been caused by any of the components located after the Developer/Fixer Crossover:
 - Fixer Rack
 - Fixer/Wash Crossover
 - Wash Rack
 - Squeegee Assembly
 - Dryer Rack
9. Install the Developer/Fixer Crossover Assembly.
10. To determine which of the components listed above may have caused the artifact, continue with the next procedure.

Isolating the Fixer/Wash Crossover Assembly

1. Remove the Fixer/Wash Crossover Assembly.
2. Feed a sheet of 35 x 43 cm (14 x 17 inch) film so that 43 cm (17-inch) edge enters the Detector Crossover Assembly first.
3. Remove the film as it exits from the Fixer Rack.
4. Rotate the film 90 degrees.
5. Manually feed the film so that the 35 cm (14-inch) edge enters the Wash Rack first.
6. Allow the film to complete the normal processing cycle.
7. Check the film for artifacts.
 - If the artifact you are diagnosing does not appear, then the Fixer/Wash Crossover Assembly is most likely the cause of the artifact.
8. Compare the sheet of film that just exited the processor with the original film displaying the artifact.
 - If the position of the artifact on the two sheets of film is the same, then the artifact most likely occurred before you rotated the film and therefore was caused in the fixer section of the processor.
 - If the position of the artifact on the two sheets of film is different by 90 degrees, then the artifact most likely occurred after you rotated the film. The artifact may then have been caused by any of the components located after the Fixer/Wash Crossover:
 - Wash Rack
 - Squeegee Assembly
 - Dryer Rack
9. Install the Fixer/Wash Crossover Assembly.
10. To determine which of the components listed above may have caused the artifact, continue with the next procedure.

Isolating the Squeegee Roller Assembly and the Dryer Assembly

1. Remove the Squeegee Roller Assembly. Only the *Kodak X-Omat* Processors listed below have a Squeegee Roller Assembly.
 - 460 RA, 480 RA, 5000 RA
 - M6 Series
2. Feed a sheet of 35 x 43 cm (14 x 17 inch) film so that 43 cm (17-inch) edge enters the Detector Crossover Assembly first.
3. Remove the film as it exits the Wash Rack.
4. Allow the film to air dry.
5. Check the film for artifacts.
 - If the artifact you are diagnosing does not appear, then the Squeegee Roller Assembly or the Dryer Assembly is most likely the cause of the artifact.
 - If the artifact does appear, then the Wash Rack is most likely the cause of the artifact.
6. Inspect the Squeegee Roller and any components in the Dryer section that may be causing the artifact.

Classifications of Artifacts

Note:

The graphics used throughout this section of the document are computer-generated and may not accurately represent the way artifacts look on film. For actual photographs or reproductions of the artifacts described in this document, see Appendix A.

Artifacts That Appear Parallel to Film Travel Include:

Delay Streaks	page 24
Entrance Roller Marks	page 26
Guide Shoe Marks	page 28
Minus Density Lines	page 30

Artifacts That Appear Perpendicular to Film Travel Include:

Chatter Lines	page 31
Film Hesitation Marks or Stub Lines	page 34
Pi Line	page 36
Slap Lines	page 38

Artifacts That Appear Randomly in Relation to the Direction of Film Travel Include:

Bent Corners	page 40
Dye Stain Marks	page 41
Flame Patterns	page 42
Kink Marks	page 43
Pick-Off Marks	page 44
Runback Marks	page 45
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Wet Pressure Marks	page 55

Artifacts That Appear Parallel to Film Travel

Delay Streaks

Appearance:

Delay Streaks appear as smooth wide lines or bands without sharp edges. They can appear as plus-density bands, minus-density bands, or a combination of both, and can appear anywhere on the film.

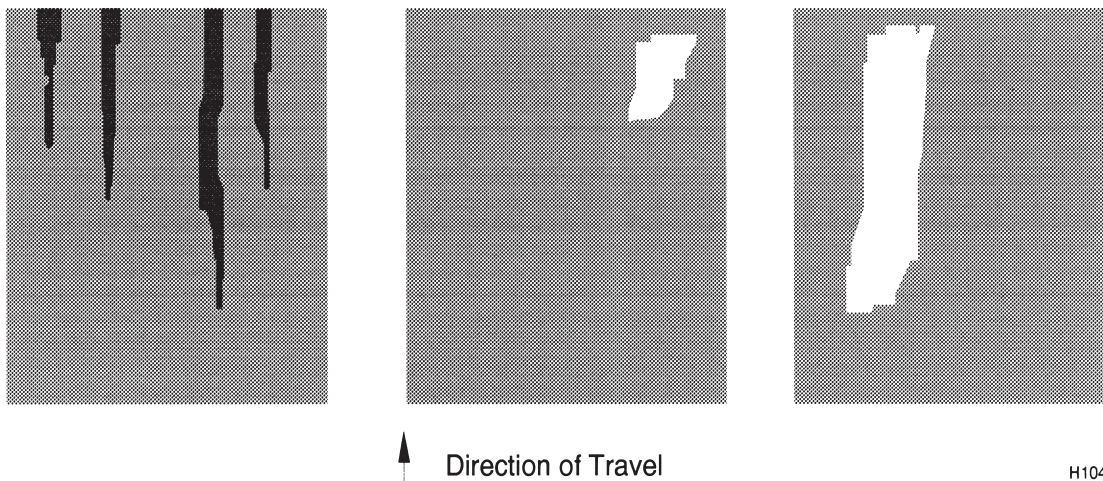
Typically; however, once the processor has been in Standby Mode for an extended period of time, the streaks appear on only the first 79.8 mm (3.14 or π inches) of film which corresponds to one revolution of the Roller. In severe cases, the Delay Streaks may show for two or even three revolutions of the Roller.

If you are processing small films, the Delay Streaks may appear on more than one film. The occurrence of streaks on multiple films depends on two factors:

- the position of the film on the Feed Tray
- the length of travel of the film.

Delay Streaks are visible in transmitted and reflected light.

Delay Streaks:



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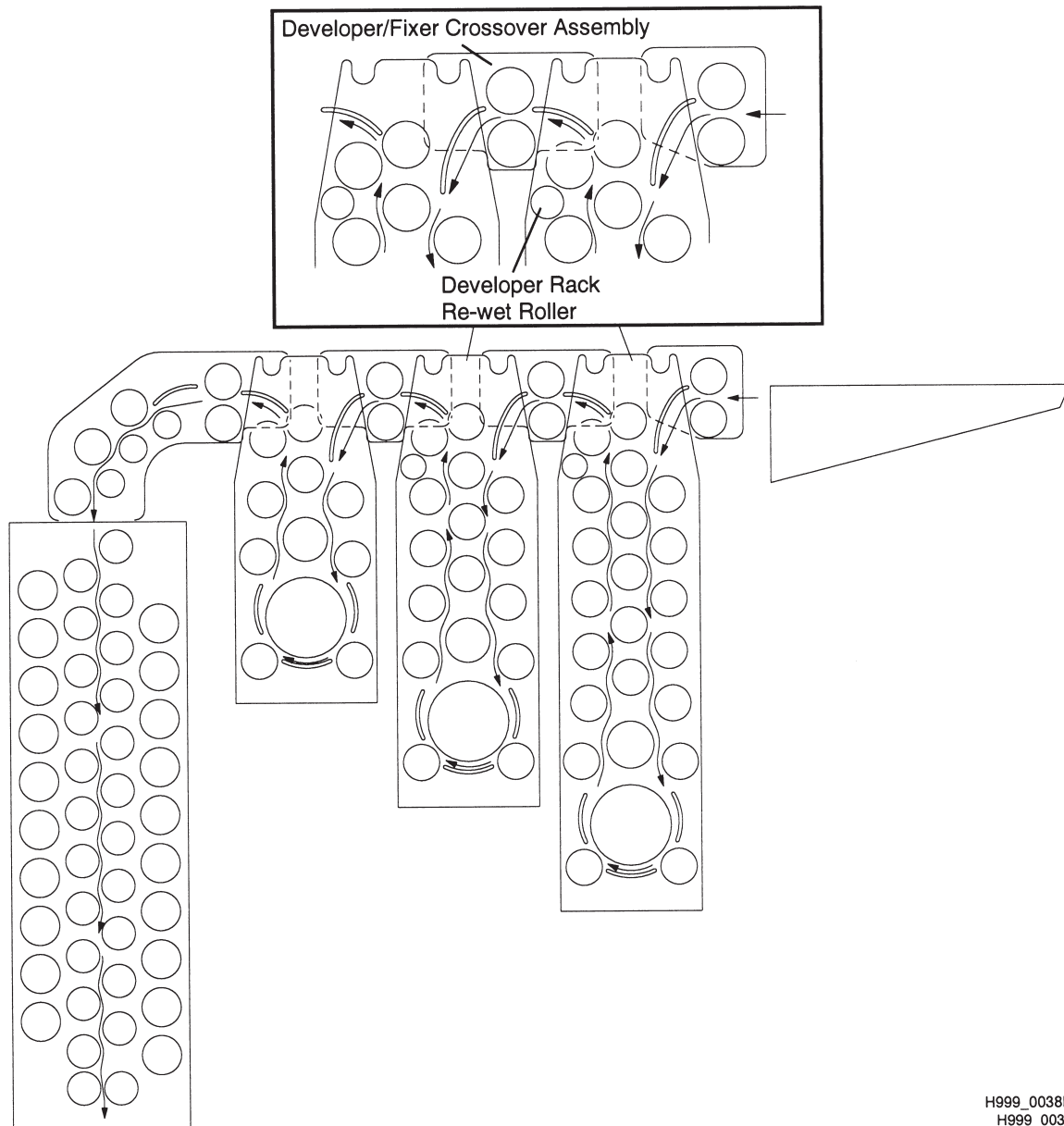
Causes:

- chemical buildup on the Developer/Fixer Crossover Rollers or the Squeegee Rollers of the Developer Rack
- low level of developer solution in the Developer Tank
- improper ventilation and darkroom air pressure
- improper leveling of the processor
- Evaporation Covers not installed

Remedies:

- Clean any dirty Rollers. If necessary, replace damaged Rollers.
- If the processor has been in Standby Mode for over 30 minutes, feed a sheet of cleanup film into the processor before you process the patient's film.

- Check that the Springs in the Racks are adjusted to the proper tension.
 - The Rewet Roller in the Rack must remain in contact with the Roller that is above the solution level. The Rewet Roller transfers solution to the Roller above the solution level in order to prevent chemical buildup.
- Check that the Developer Tank is full of solution.
- Check that the processor is vented correctly using the manufacturer's specifications.
- Check that the processor is level.
- Check that the Evaporation Covers are installed.



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Entrance Roller Marks

Appearance:

Entrance Roller Marks appear as plus-density bands approximately 0.13 mm (1/8 inch) wide. The location of the marks on the film can vary with three factors:

- pressure
- moisture
- light

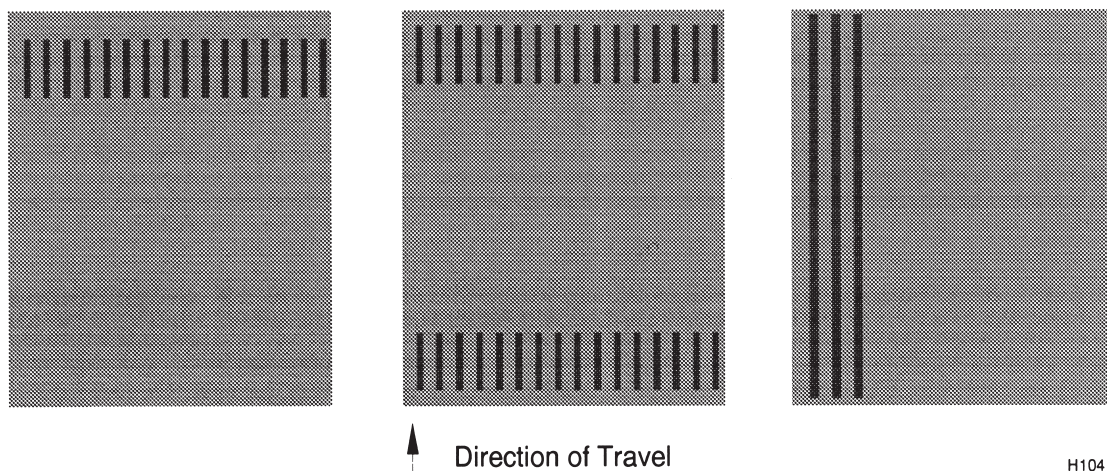
Entrance Marks caused by pressure are uniform over the length of the film. If you are processing small films, Entrance Marks caused by pressure may appear only on one of the two side edges of the film (drive side or non-drive side).

Entrance Marks caused by moisture can be continuous or random. Generally, the marks will decrease in density across the film as the moisture is transferred from the Rollers to the film.

Entrance Marks caused by light appear near the trailing edge of the film.

Entrance Marks are most visible in transmitted light, but in severe cases are also visible in reflected light.

Entrance Roller Marks:



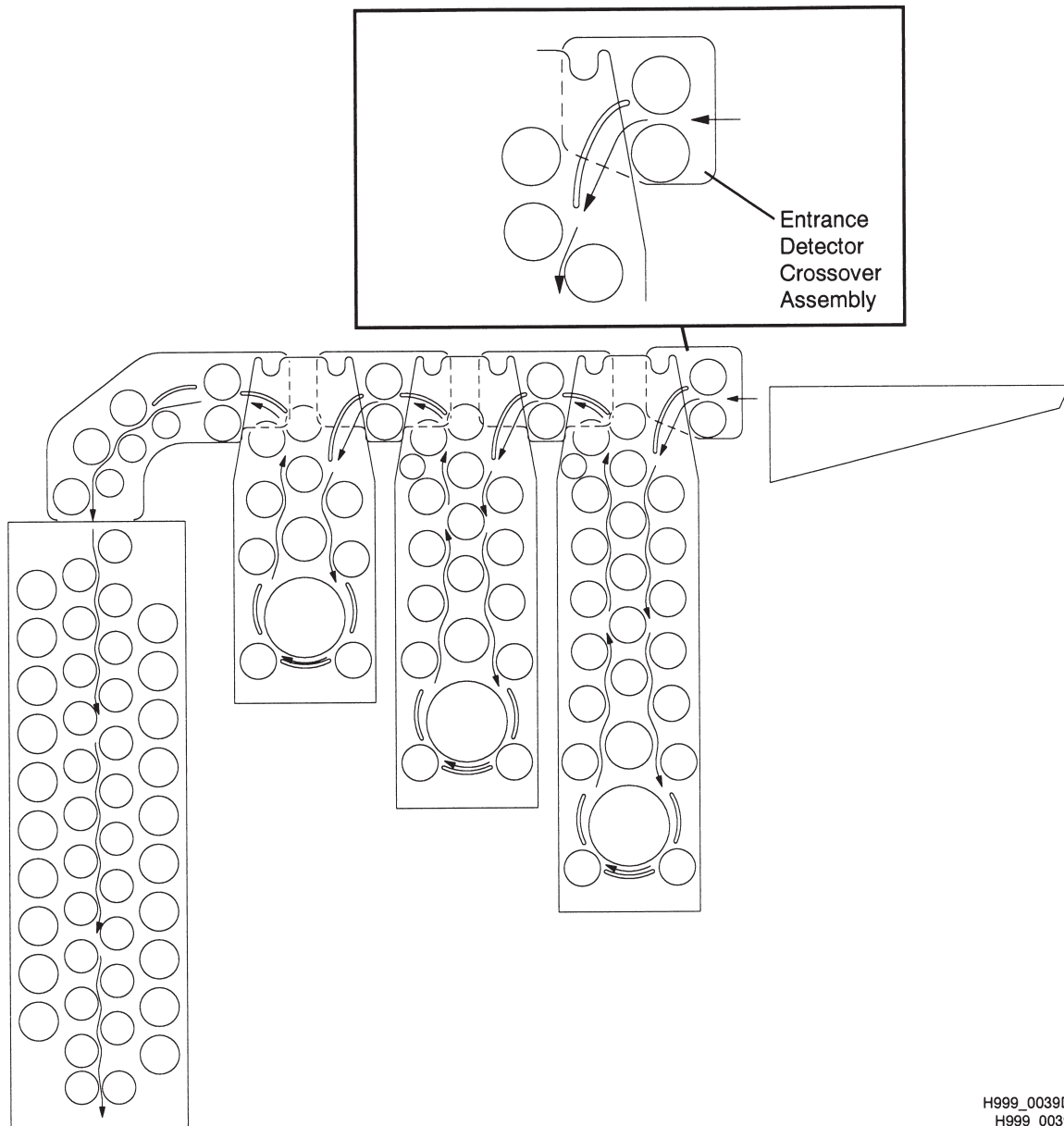
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Causes:

- excess pressure from the Entrance Rollers
- moisture on the Entrance Rollers
- light exposing the film before the trailing edge of the film exits the Entrance Roller

Remedies:

- Check that the Entrance Roller Assembly is positioned correctly in the processor.
- Check the Entrance Roller Assembly for:
 - squareness
 - warped or defective Rollers
 - worn Bearings
- Clean the Entrance Rollers with a damp cloth and dry them thoroughly before you process any patient films.
- Check that the processor is vented correctly using the manufacturer's specifications.



H999_0039DCA
H999_0039DA

Guide Shoe Marks

Appearance:

Guide Shoe Marks can appear as either plus-density or minus-density scratches. Guide Shoe Marks are typically easy to identify because they appear at regular intervals.

Guide Shoe Marks caused by ribbed Guide Shoes appear at 25.4 mm (1 inch) or a multiple of 25.4 mm (1-inch) intervals.

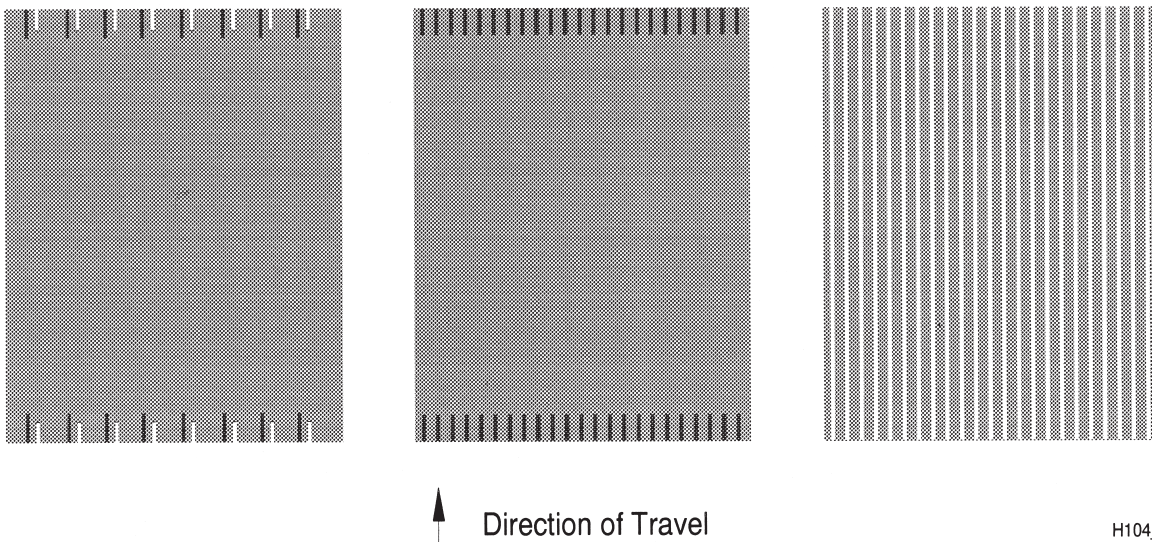
Marks caused by textured Guide Shoes appear at 0.06 mm (1/16 inch) or a multiple of 0.06 mm (1/16-inch) intervals.

Guide Shoe Marks occurring in processors that contain both types of Guide Shoes can take on several different appearances:

- short scratches that appear on the leading or trailing edge of the film
- long scratches that extend the entire length of the film
- randomly spaced scratches

Guide Shoe Marks are visible in either transmitted or reflected light.

Guide Shoe Marks (May be Plus or Minus Density):



H104_0491BC

Causes:

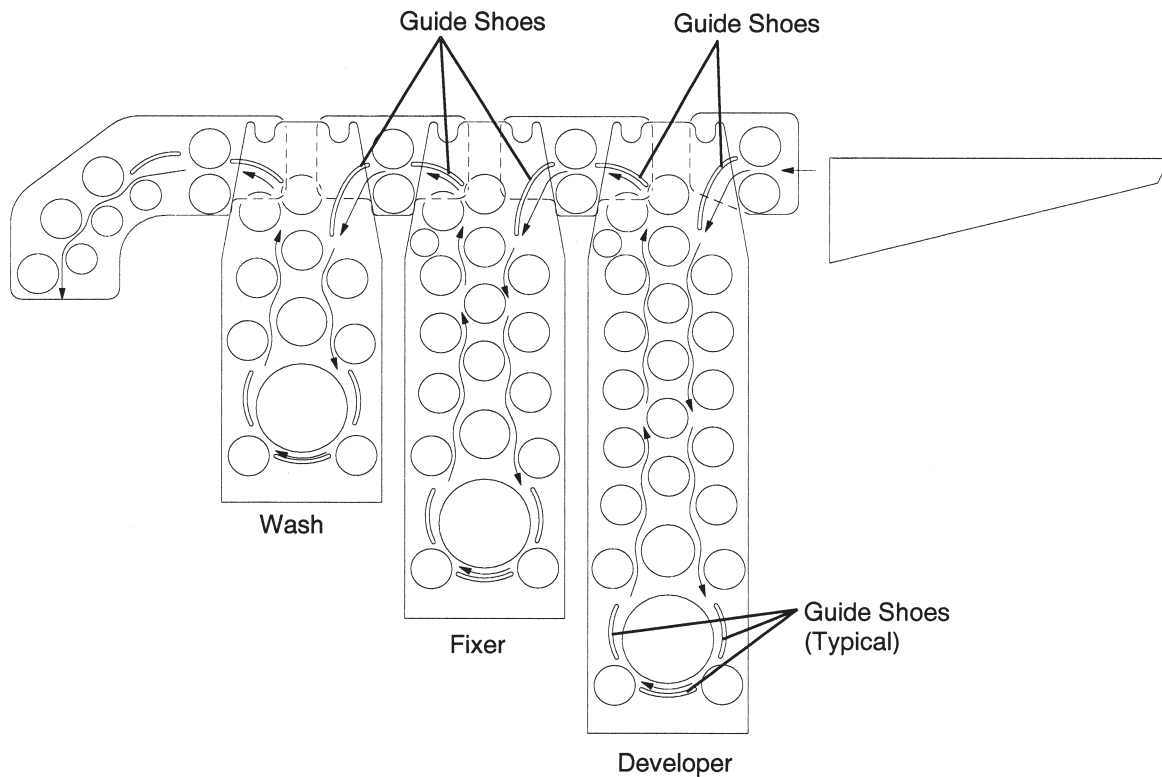
Guide Shoe Marks occur when the Guide Shoes apply pressure to the film during transport. If the Guide Shoes apply pressure to the film before or during the development process, the artifacts appear as plus-density marks. If the Guide Shoes apply pressure to the film after the development process, the artifacts appear as minus-density marks. In some cases, the pressure applied to the film by the Guide Shoe may be so great that the Guide Shoe gouges the film surface leaving a minus-density mark on the film.

- If the Guide Shoe Marks appear on the top surface of the film, the marks are most likely caused by one of the Crossover Assemblies.
- If the Guide Shoe Marks appear on the bottom surface of the film, the marks are most likely caused by one of the Turnaround Assemblies or by the Guide Shoes in the Dryer Rack.

- Additional causes of Guide Shoe Marks include:
 - chemical deposits on the Guide Shoes (i.e., dried fixer solution)
 - corrosion of the Guide Shoes
 - worn Bearings or Roller components that misguide the film against the Guide Shoes

Remedies:

- Check that all Rollers are straight and rotating correctly.
- Check all the Racks for squareness.
- Inspect all Guide Shoes, and replace any bent Guide Shoes.
- Check the Roller Bearings for wear. If necessary, install new Bearings.
- Inspect all Rollers for dirt or a buildup of dried chemicals. Clean the Rollers according to the manufacturer's recommendations. Do not use abrasive materials to clean the Rollers or Guide Shoes.

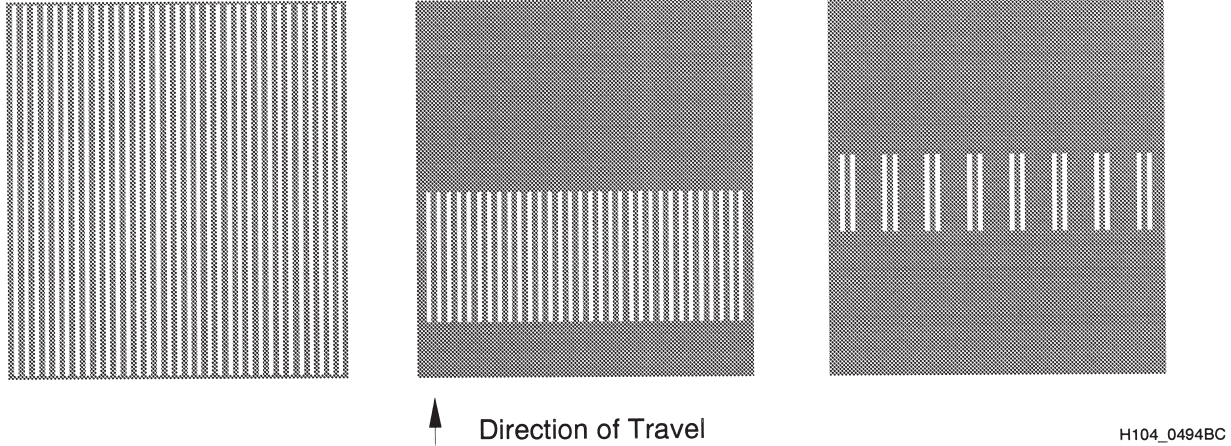


H999_0036DCA
H999_0036DA

Minus Density Lines

Appearance: Minus Density Lines appear as light streaks and are normally visible only in transmitted light.

Minus Density Lines:



Causes of Top Surface Artifacts:

- dirty Exit Guide Shoe in the Fixer/Wash Crossover
- bent Guide Shoes in either the Wash or Dryer Racks
- worn Bearings in the Fixer or Wash Turnaround Assemblies

Remedies for Top Surface Artifacts:

- Clean the Exit Guide Shoe in the Fixer/Wash Crossover.
- Replace any bent Guide Shoes.
- Replace any worn Bearings.

Causes of Bottom Surface Artifacts:

- physical pressure on the film occurring before exposure (handling) of the film
- bent Guide Shoes in the Fixer or Wash Turnaround Assemblies
- worn Bearings in the Fixer Turnaround Assembly

Remedies for Bottom Surface Artifacts:

- Replace any bent Guide Shoes.
- Replace any worn Bearings.

Artifacts That Appear Perpendicular to Film Travel

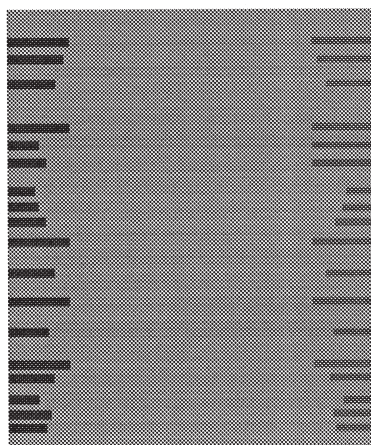
Chatter Lines

Appearance:

Chatter Lines appear as plus-density bands that occur at regular intervals which correspond to the spacing of the Sprocket and/or Gear Teeth in the Rack. Chatter Lines due to Gear chatter regularly occur every 0.13 mm (1/8 inch). Chatter Lines due to Chain chatter regularly occur every 0.4 mm (3/8 inch).

Chatter Lines are most visible in transmitted light, but in severe cases are also visible in reflected light.

Chatter:



Direction of Travel

H104_0484BC

Causes:

Chatter Lines can be caused by Drive Chains or Gears that do not drive smoothly.

Gear Chatter

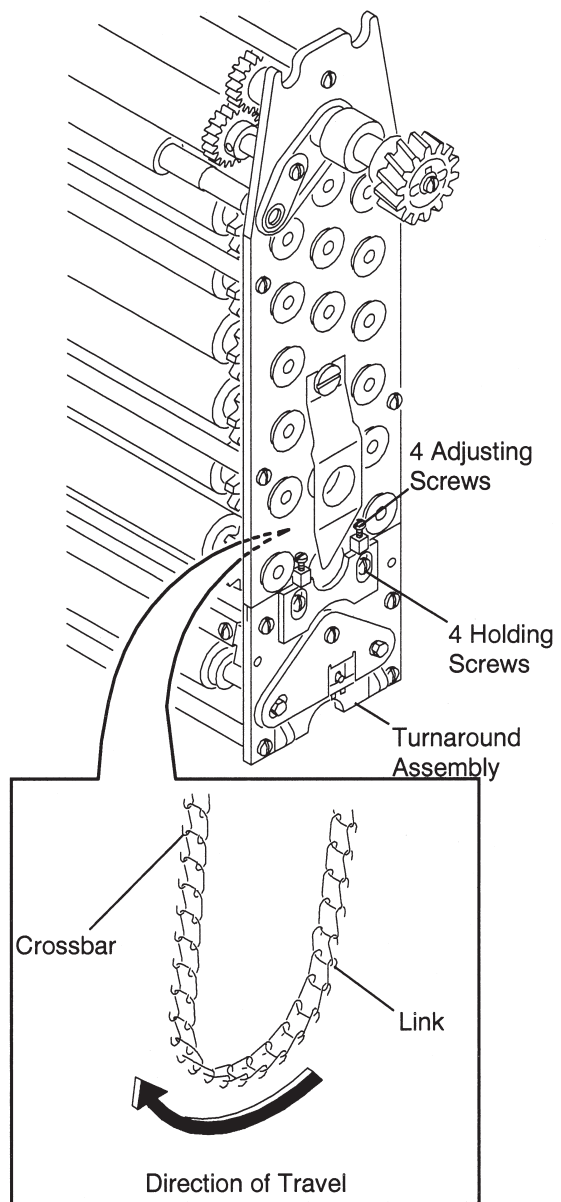
- Gears on the Exit Rollers of the Developer Rack that are not properly aligned, are worn, or are damaged
- the drive mechanism on the Developer/Fixer Crossover Assembly that is too loose or too tight
- worn or broken Gear Teeth
- loose Setscrew or Pins
- wrong size Gear
- Drive Shaft out of alignment with the Worm Gears
- chemical buildup on the Gears
- Gears out of adjustment
- worn or corroded Worm Gears or Sideplate

Chain Chatter

- a Drive Chain or a Ladder Chain on the Developer Rack that is too loose, too tight, worn or bent
- the Sprockets are not aligned correctly
- worn or damaged Sprockets
- incorrectly assembled Ladder Chain
- rusty Main Drive Chain
- preventive maintenance procedures not performed regularly

Remedies:

- Adjust the drive system on the Developer Rack or Developer/Fixer Crossover Assembly according to the manufacturer's recommendations.
- Check for worn or damaged Sprockets that could prevent correct meshing with the Chain.
- Check for the correct tension of the Rack Chain.
- Check whether the Chain on the Drive Motor is worn or corroded. If necessary, install a new Chain.
- Install a new Ladder Chain.
- Do the Periodic Maintenance procedures as outlined in the Service Manual.



H048_0125CCB
H048_0125CA

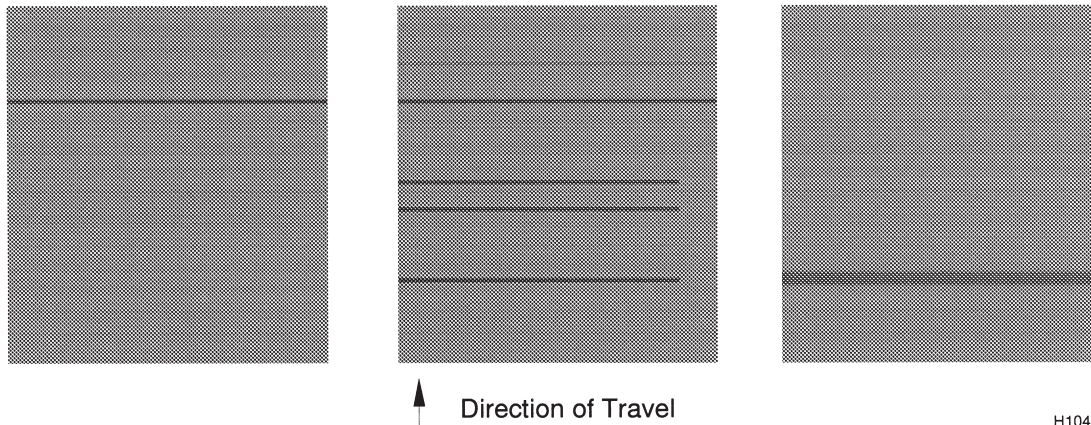
Film Hesitation Marks or Stub Lines

Appearance:

Film Hesitation Marks or Stub Lines appear as plus-density and minus-density lines or bands. The marks or lines can appear anywhere on the film at regular or irregular intervals.

Film Hesitation Marks are usually visible in transmitted light.

Stub Lines:



H104_0483BC

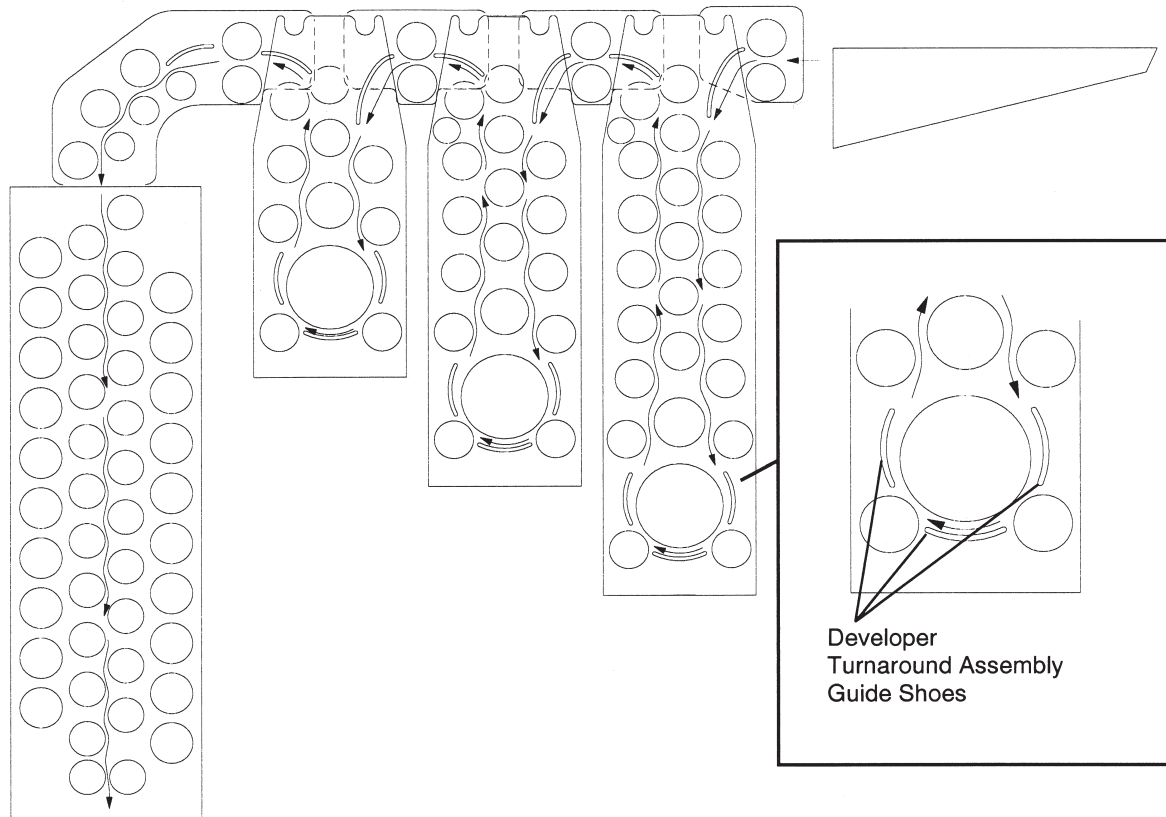
Causes:

- change in velocity of the film travel resulting from interference within the film path
- malfunctioning Rack or Drive Component, such as a Roller, Gear, Chain, Drive Motor, or Sprocket
- incorrectly assembled or damaged Guide Shoes
- Guide Shoes out of adjustment or out of alignment
- chemical buildup on the Rollers
- warped or rough Rollers
- worn Roller Bearings, Shafts, and Sideplates
- Idler Rollers are not turning
- a damaged Gear or Gudgeon
- inactive or contaminated chemicals

Remedies:

- As necessary, repair or replace Rollers and Bearings, Shafts, Sideplates, Gears, Gudgeons, and Guide Shoes. Guide Shoes can be adjusted on the *Kodak X-Omat* M35A-M and 3000 RA Processors.
- Check that the Guide Shoes are not loose and are positioned in the correct direction.
- Check that the Sideplates of the Guide Shoes are correctly oriented.
- Adjust the Rack Chains.

- Check that the Developer Rack and Developer/Fixer Crossover are assembled correctly.
- Mix new processing chemicals.
- Check the replenishment rates of the developer and fixer solutions.
- Check for kinks or air bubbles in the Replenishment Hoses.
- Inspect all Rollers for dirt and a buildup of dried chemicals. Clean the Rollers according to manufacturer's recommendations. Do not use abrasive materials to clean Rollers or Guide Shoes.



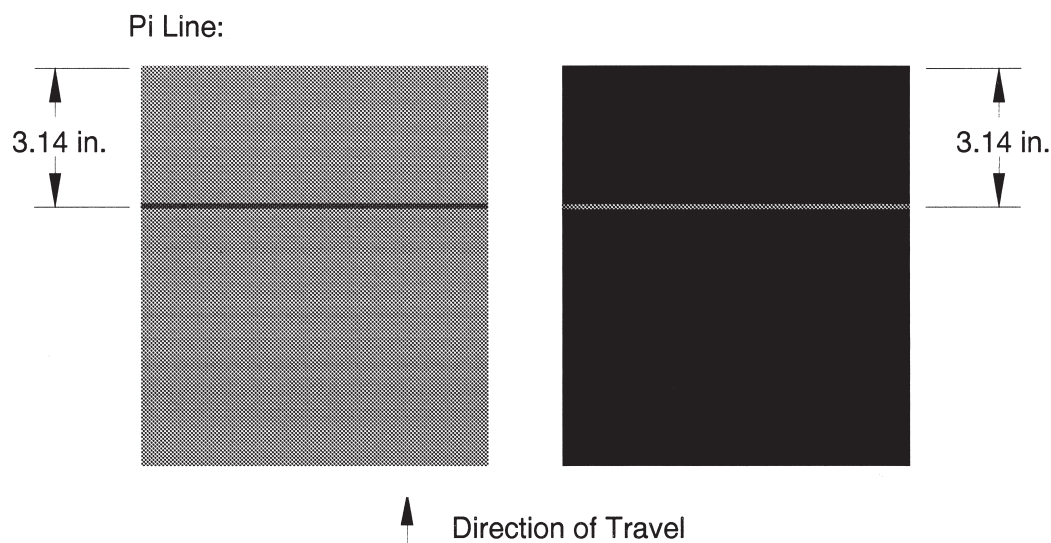
H999_0040DCA
H999_0040DA

Pi Lines

Appearance:

Pi Lines appear as plus-density lines that occur 79.8 mm (3.14 or π inches) from the leading edge of the film and extend for the full width of the film. If however, you are processing film with rounded corners, the Pi Lines will not extend from edge to edge, but will only be the width of the straight portion of the film.

Pi Lines can be first seen in reflected light. As the severity of the Pi Line artifact increases, you will be able to see the lines in transmitted light. In the most severe cases, you will be able to see the Pi Line repeat every 79.8 mm (3.14 inches) for the entire length of the film with each occurrence being less dense than the previous.



H104_0497BC

Causes:

The Pi Line is created from a deposit of foreign material on a 25.4 mm (1-inch) Roller. Occasionally, the leading edge of a film will stub on a Roller. The stubbing action deposits a small amount of emulsion onto the Roller. As that Roller turns, it deposits the foreign material onto the film. Typically the streaks appear on only the first 79.8 mm (3.14 or π inches) of film which corresponds to one revolution of the Roller.

Causes for the film stubbing include:

- dirty Rollers
- chemical buildup
- foreign material floating in the processing solutions
- Rollers that are out of position because of:
 - worn Shafts
 - worn Bearings
 - bent Guide Shoes

Remedies:

- Check for excessive stubbing on Rollers.
 - Remove the Rack.
 - Rinse and dry the Rack.
 - Manually feed a sheet of film and again check for excessive stubbing on the Roller.
- Inspect all Rollers for rough spots (i.e., Rollers cleaned with an abrasive pad). If necessary, install new Rollers.
- Inspect all Rollers for a buildup of dirt. Clean the Rollers according to the manufacturer's recommendations. Do not use abrasive materials to clean the Rollers.

Note:

New Rollers or Rollers that you have cleaned recently may cause a Pi Line. The Pi Line will occur only for a brief time and will disappear once you process more film.

- Replace any worn Bearings.
- Replace any bent Guide Shoes.

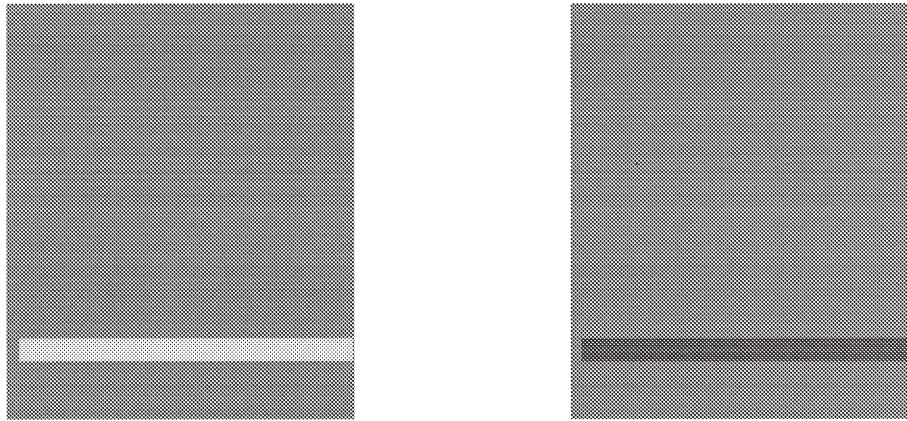
Slap Lines

Appearance:

A Slap Line appears as a plus-density or minus-density, broad band that is located approximately 0.75 to 2.35 mm (3/4 to 2 1/4 inches) from the trailing edge of the film. The band can be up to 0.25 mm (1/4-inch) wide and does not have sharp edges.

Slap Lines are normally visible only in transmitted light.

Slap Lines:



Direction of Travel

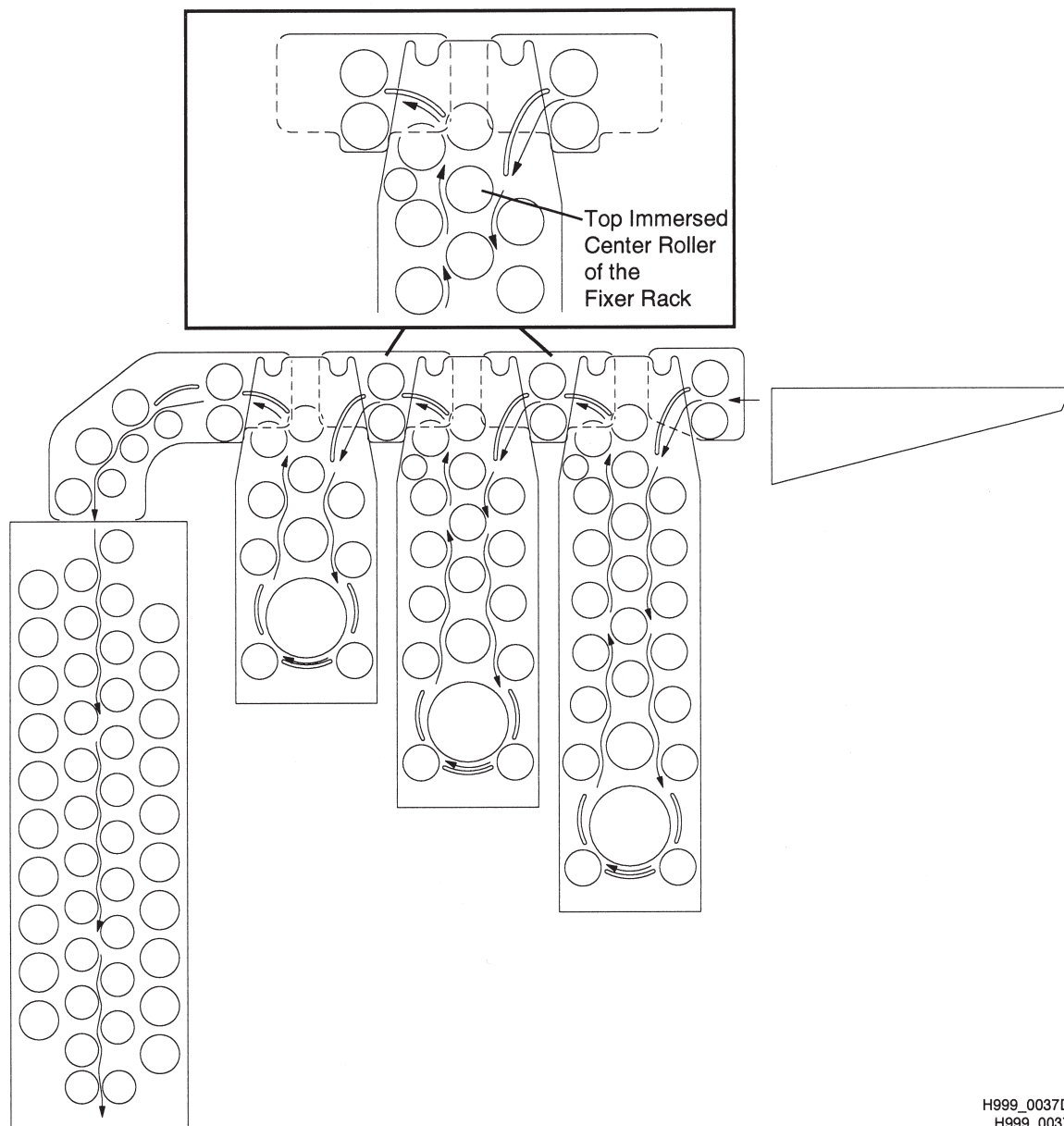
H104_0485BC

Causes:

- Minus-density Slap Lines occur when the trailing edge of the film abruptly releases from the Developer/Fixer Crossover and slaps the partially immersed top, center Roller of the Fixer Rack.
- Plus-density Slap Lines occur when the trailing edge of the film abruptly releases from the Detector Crossover Assembly and slaps the top, center Roller of the Developer Rack.
- low levels of processing solutions
- incorrect replenishment rates
- inactive processing solutions
- malfunctioning Exit Squeegee Assembly in the Developer Rack
- incorrect Roller configuration in the Fixer Rack
- incorrect transport speed between the Developer and the Fixer Rack
- Developer/Fixer Crossover that is not square
- malfunctioning Squeegee Assembly in the Developer/Fixer Crossover
- Entrance Detector Assembly not working correctly

Remedies:

- Check replenishment levels.
- Adjust the replenishment rates.
- Mix new processing solutions.
- Use the Rollers recommended by the processor manufacturer.
- Check that the Guide Shoes in the Developer/Fixer Crossover are correctly positioned and are not damaged.



H999_0037DCA
H999_0037DA

Artifacts That Appear Randomly in Relation to the Direction of Film Travel

Bent Corners

Appearance:

Bent Corner artifacts appear as triangular shaped areas of plus density (if it occurs in the Developer Tank) or minus density (if it occurs in the Fixer Tank) on a leading corner of the film. The corner of the film actually folds and a crease forms.

Bent Corners can occur on any size film, but occur most frequently on larger size films. The size and location of the crease can vary.

Bent Corners are easy to recognize because once a leading corner of the film is bent, you can hear the film flutter or stub on the Rollers as it is transported through the Racks.

Bent Corners:



Direction of Travel

H104_0490AC

Causes:

Bent Corners are often caused by excessive recirculation of solutions or a change in the direction of the recirculation in the Tank which causes the film to flutter, stub, and bend on a Roller.

Additional causes for the film stubbing include:

- recirculation rates set too high
- Rollers or Guide Shoes that are not correctly positioned
- wrong or missing Orifice
- wrong or missing Developer Rack Baffle

Remedies:

- Check that all Rollers and Guide Shoes are assembled and located correctly.
- Check for the correct size Orifices in the Recirculation System.
- Check that the Baffle is installed in the Developer Rack, if applicable.
- Check that films are being fed into the processor correctly.
- Check that the correct Developer Filter is installed and that it is clean.

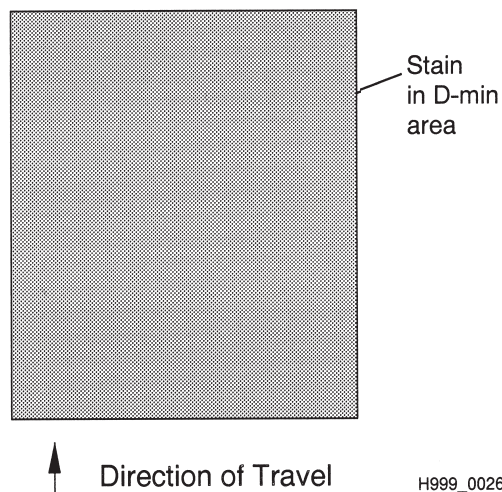
Dye Stain Marks

Appearance:

Dye Stain Marks usually appear as pink areas or blotches in the D-min area of the film. The color of the Dye Stain may vary with film type.

Dye Stain Marks are visible when you view the film.

Dye Stain:



Causes:

- incomplete removal of the sensitizing dye resulting from
 - inactive processing solutions
 - fixer replenishment rate set too low
 - fixer or water temperatures set too low
 - increased transport speed through the fixer solution

Remedies:

- Mix new processing solutions.
- Increase the replenishment rate for the fixer solution.
- Increase the fixer or water temperatures.
- Ensure that film is transported through the processor according to the manufacturer's recommendations (i.e., the proper cycle for the specific film).

Flame Patterns

Appearance:

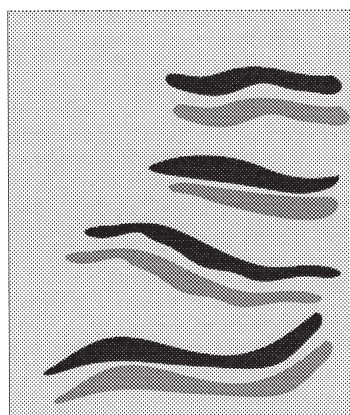
A Flame Pattern artifact appears as variations in the density of the film and looks like a flame.

Typically, Flame Patterns are visible in transmitted light and are more difficult to see in reflected light.

Note:

Drying Streaks and Dryer Pattern artifacts can resemble Flame Pattern artifacts. For more details on Drying Streaks and Dryer Pattern artifacts, see page 51.

Flame Patterns:



Direction of Travel

H999_0027AC

Causes:

- incorrect recirculation rate of the developer solution
- restricted, plugged, or incorrect configuration of the Recirculation Inlet
- dirty Developer Filter
- kinked Recirculation Hose
- missing, wrong or misplaced Orifice in the Recirculation Hose
- missing Baffle from the Developer Rack
- inoperative Recirculation Pump

Remedies:

- Check for the recirculation of the developer solution.
- Change the Developer Filter regularly using the manufacturer's recommended Filter.
- Check the Recirculation Hoses for kinks or air bubbles.
- Install only the manufacturer's recommended Orifice in the Developer Recirculation System and in the correct position.
- Check that the Baffle is installed on the Developer Rack.
- Check the operation of the Recirculation Pump.

Kink Marks

Appearance:

Kink Marks can appear as either plus-density or minus-density crescent-shaped marks that resemble thumbnail marks or eyelashes. Kink Marks can occur anywhere on the film.

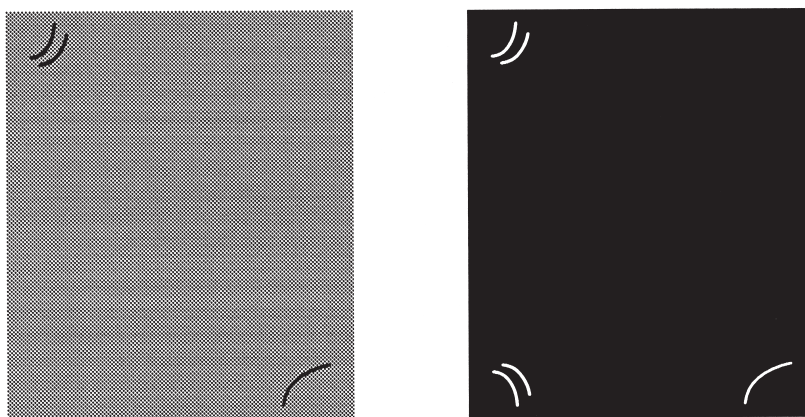
Plus-density Kink Marks indicate that the film was poorly handled after the film was exposed. Minus-density Kink Marks indicate that the film was poorly handled before the film was exposed. Kink artifacts can also affect the area immediately surrounding the actual mark.

Kink Marks are visible when you view the film. Severe kinking can be seen as a crease in the film in reflected light.

Note:

Kink Marks that appear on *T-Mat* films only appear as plus-density artifacts regardless of when the poor film handling occurred.

Kink Marks:



Direction of Travel

H104_0488BC

Causes:

- pressure on the film during the handling of the film
- bending, folding, or creasing a portion of the film

Remedies:

- Handle films carefully.
- Do not bend, fold, or crease films.

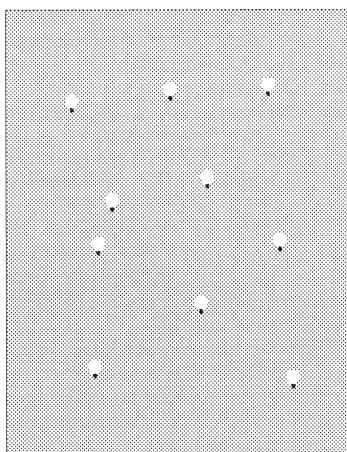
Pick-Off Marks

Appearance:

Pick-Off Marks appear as very small light spots on the film where the emulsion has been removed down to the film base. Often the piece of the emulsion that is removed may be deposited on the film near the trailing edge of the minus-density mark or may be deposited randomly on the film. Pick-Off Marks are most apparent on single-emulsion films.

Pick-Off Marks are most visible in transmitted light. Unlike shadow images, Pick-Off Marks can be seen in reflected light.

Pick-off Marks:



Direction of Travel

H999_0028AC

Causes:

- rough Rollers
- varying transport speed
- inactive processing chemicals
- inadequate film/emulsion formulation

Remedies:

- Do the Periodic Maintenance procedures as outlined in the Service Manual.
- Mix new processing solutions.
- Check the surface finish of the knurled Rollers for excessively sharp or rough areas. If necessary, install new Rollers.
- Check the replenishment rates for the developer and fixer solutions.

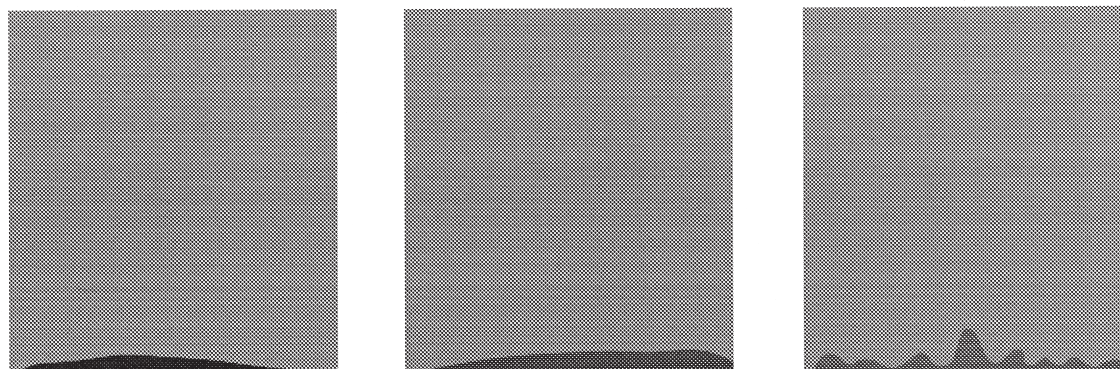
Runback Marks

Appearance:

Runback Marks usually appear as dark, wavy areas on the trailing edge of the film. Occasionally however, the marks may extend up to 76.2 mm (3 inches) into the film. The length of the Runback Marks depends on the transport speed of the processor. The marks are more pronounced at slower speeds. The marks are more common on single-emulsion films.

Runback Marks are most visible in transmitted light.

Runback:



Direction of Travel

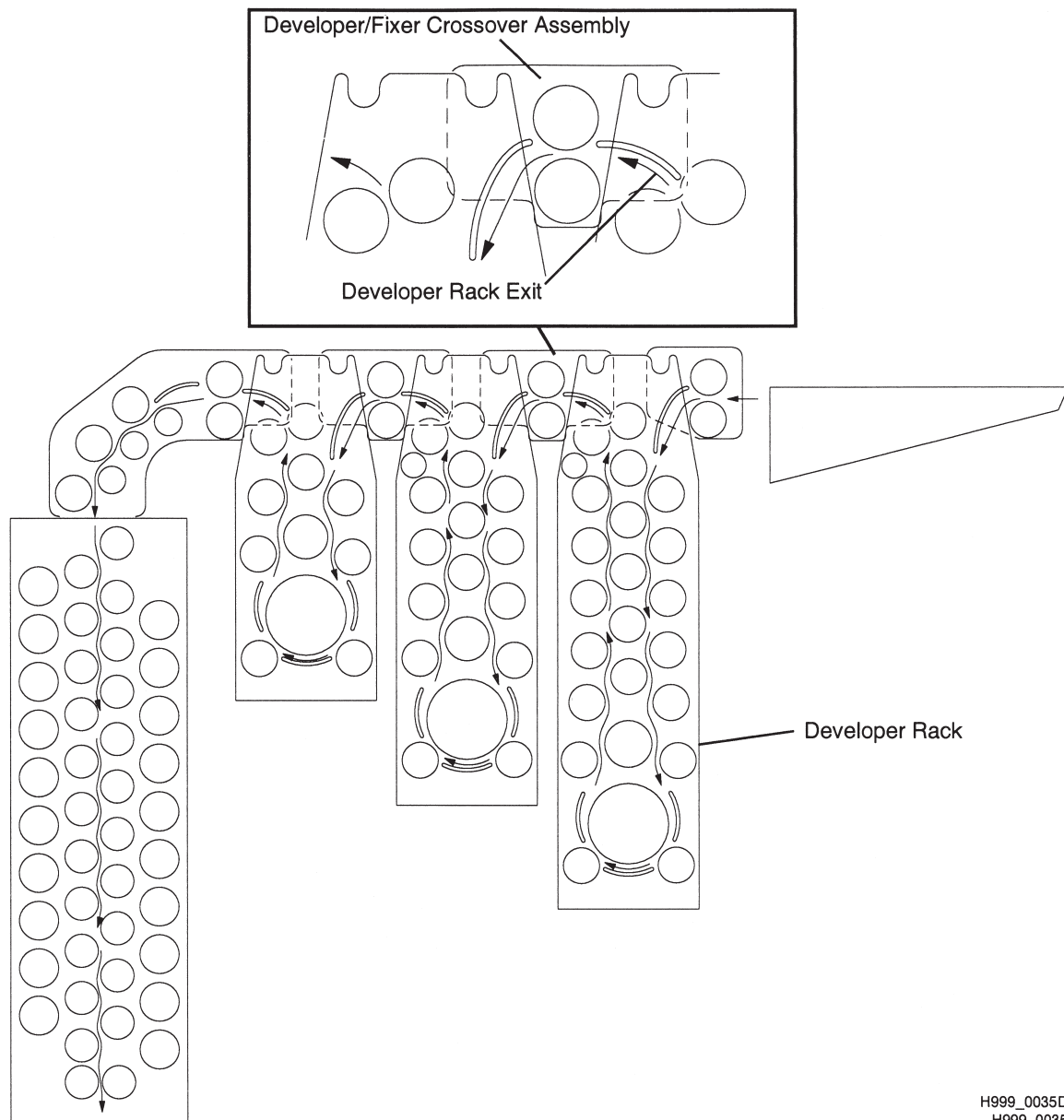
H104_0493BC

Causes:

- incomplete removal of developer solution from the film as the film exits the Developer/Fixer Crossover causes developer solution to run down the trailing edge of the film
- low solution level in the Developer or Fixer Tank of the processor causing the Rewet Roller to be dry

Remedies:

- Clean the Developer/Fixer Crossover daily with warm water.
 - If cleaning does not solve the problem, Roller modifications are available for some processors.
- Check the tension of the Springs on the two Rollers in the Squeegee Assembly of the Developer/Fixer Crossover. If necessary, install new Springs.
- Check the tension of the Springs on the Squeegee Rollers in the Developer Rack and Rollers in the Developer/Fixer Crossover. If necessary, install new Springs.
- Check for the correct configuration of Squeegee Rollers and Rollers in Developer/Fixer Crossover.
- Replace any warped Rollers.
- Replace any worn Bearings.
- Refill the solution in Developer or Fixer Tank of processor.



H999_0035DCB
H999_0035DA

Shadow Images

Appearance:

Shadow Images appear as small, random, light spots on the film. They are most apparent on single-emulsion films such as mammography films.

Shadow Images are visible only in transmitted light.

Shadow Images:



Direction of Travel

H104_0482AC

Causes:

- dirt or dust on the Intensifying Screens
- dirt or dust in the Cassette

Remedies:

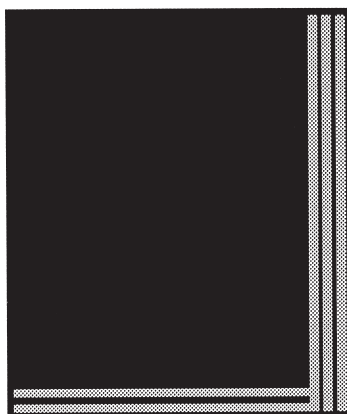
- Check that the Intensifying Screens are clean and free of dirt and dust.
- Keep the darkroom clean.
- Check for the correct filtration of incoming air.
- Evaluate the darkroom for features which may contribute to ongoing dirt and dust problems.
- Do not install false ceilings in any darkroom. If a false ceiling is already installed, ask the manufacturer for a recommended sealant. Seal the ceiling in accordance with local codes.
- Use a blacklight to inspect the darkroom for dust.

Shoreline Patterns

Appearance:

Shoreline Patterns appear as a series of waves on the edges of a film, or as a variation in the gloss of the film surface. Shoreline Patterns only appear on the emulsion side of the film. Generally, this artifact is only visible in reflected light; however, if the artifact is severe, the pattern will be visible in transmitted light as a density variation on the edges of the film.

Shoreline:



H999_0029AC

Causes:

- Dryer temperature set too high
- poor airflow
- diluted fixer solution
- wash water that is too cold
- obstructed Air Tubes
- orientation of Air Tubes
- insufficient Squeegee action
- conditions not within the site specification (environment, exhaust, venting)

Remedies:

- Lower the temperature setting for the Dryer until the film exits the processor "just dry," but not hot to the touch.
- Mix new processing solutions.
- Increase the temperature of the wash water (but not higher than the specification).
- See the section on Surface Drying Streaks on page 51.

Important:

Increasing the temperature setting for the Dryer (if films are tacky) may cause additional artifacts.

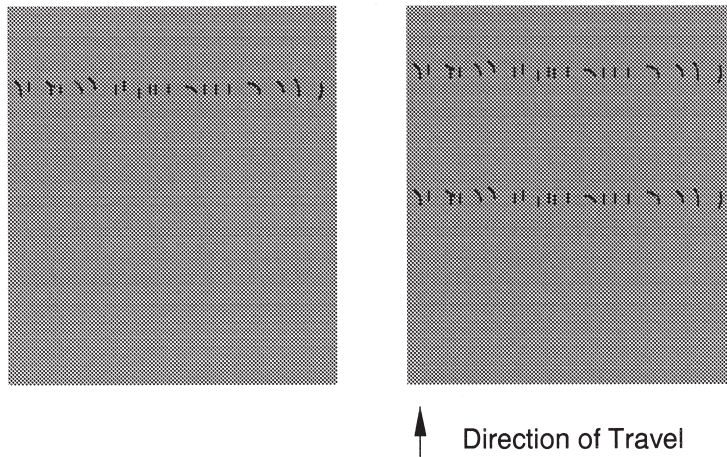
Skiving Marks

Appearance:

Skiving Marks appear as thin slivers of dark emulsion. Typically, Skiving Marks appear 79.8 mm (3.14 inches) from the leading edge of the film, but they may appear anywhere on the film.

Skiving Marks are visible in transmitted light and may also be seen in reflected light. Often you will be able to feel the Skiving Marks on the surface of the film and be able to remove them from the film by using a knife.

Skivings:



H104_0481BC

Causes:

- film stubbing in the processor
- inactive developer solution

Remedies:

- Do the Periodic Maintenance procedures as outlined in the Service Manual.
- Make sure that the Developer Filter is installed.
- Mix new processing solutions.
- Check the replenishment rates for the developer and fixer solutions.
- Check the edges of the film for loose emulsion. If necessary, use a new sheet of film.
- Clean the Racks.
- Check that the Guide Shoe is correctly positioned in the Detector Crossover Assembly.

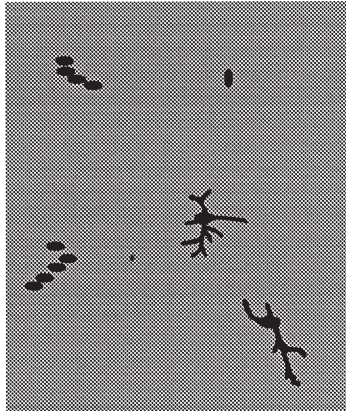
Static Marks

Appearance:

Artifacts caused by static appear as random, plus-density (dark) splotches which resemble a lightning bolt, tree branch, or a cluster of dots and dashes.

Static Marks are most visible in transmitted light, but in severe cases are also visible in reflected light.

Static:



Direction of Travel

H104_0489AC

Causes:

- electrostatic discharge on the surface of the film caused by dry air or static from:
 - certain clothing
 - carpeting
 - Feed Tray
 - low relative humidity

Remedies:

- Apply anti-static cleaner on the Feed Tray, Screens, and Cassettes.
- Install an anti-static mat.
- Ensure that the relative humidity in the darkroom remains between 30 and 50%
 - If necessary, use a humidifier to increase room humidity.
- Ground the Feed Tray.

Surface Drying Streaks and Dryer Patterns

Appearance:

Surface Drying Streaks or Dryer Patterns appear as surface artifacts of non-uniform density. The streaks can contain areas that appear shiny, as well as areas that appear glossy. Surface Streaks and Dryer Patterns are visible in reflected light, but in severe cases may also be seen in transmitted light.

Surface Drying Streaks:



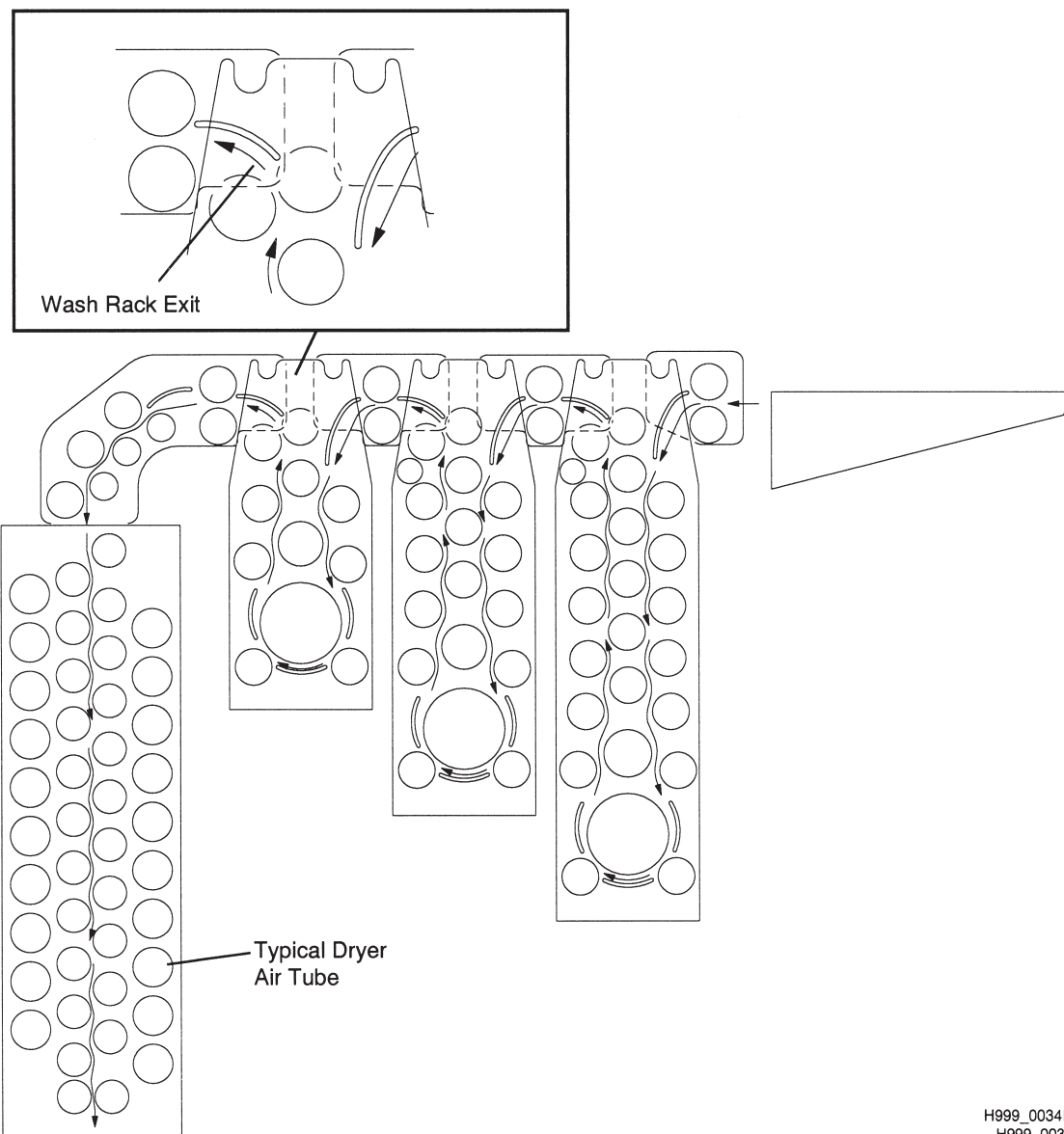
Direction of Travel

H104_0540AC

Causes:

- Dryer Patterns are caused by an uneven removal of water from the film. This may be due to non-uniform airflow in the Dryer section. The patterns may also be from drying the film too fast. However, if the film is not dry as it exits the Dryer section, the film may be damp enough to pick up patterns from the exit Rollers, the Dryer Bin, or other films.
- inactive processing solutions
- Squeegee Rollers or Dryer Rollers that are dirty or malfunctioning
- Air Tubes that are dirty or out of position
- Dryer temperature that is too high or too low
- inadequate venting of the processor
- excessive airflow
- wash water that is too cold or too hot
- uneven removal of water from film
- Dryer Roller installed in wrong orientation
- obstructed airflow path
- obstructed Air Tube
- Air Tubes installed in the wrong orientation
- missing Baffle or Seal (Dryer Plenum)
- no water in Wash Tank or improper recirculation of wash water

- worn Squeegee or Dryer Roller Bearings
- insufficient squeegee action
- too much airflow
- poor drive in Dryer
- intermittent Interlock Switch
- processing film in incorrect chemical solution
e.g., use of RP film with RA chemicals
- exhausted chemistry
- level of wash water that is too low
- Dryer Belt that is too loose
- incorrect type of film or chemicals used for the processor model



H999_0034DCA
H999_0034DA

Remedies:

- Check the developer and fixer replenishment rates.
- Check for kinks or air bubbles in the Replenishment Hoses.
- Mix new processing solutions.
- Clean the Rollers.
- Check that the Rollers are positioned correctly.
- Inspect the Springs on the Squeegee Rollers. If necessary, install new Springs.
- Clean the Air Tubes.
- Check that the Air Tubes are adjusted correctly.
- Check for the correct style Air Tube for the operating cycle and the processor model being used.
- Increase the Dryer temperature so that film exiting is just dry.
 - Set the Dryer temperature to the lowest setting that will still dry film.
- Adjust the ventilation for the processor according to the procedure outlined in the Site Specifications.
- If applicable, check that the Blower Motor Pulley is correctly positioned.
- Increase the temperature of the incoming wash water.
- Check that the Wash Tank is full of water.
- If applicable, check that the tension of the Dryer Belt is correct.
- Use only RA developer, RA fixer, and RA film when operating any RA Processor in the K/RA Cycle.
- Use only RP developer and RP fixer, but either RA or RP film when operating the processor in the Standard or Rapid Cycle.
- Replace any worn Bearings.

Note:

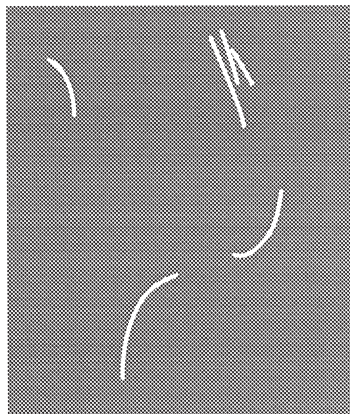
Always use the temperature setpoints recommended by the manufacturer for your particular combination of film and processing chemicals.

Surface Scratches

Appearance:

Surface Scratches can appear as either plus-density or minus-density (dark or light) marks.

Surface Scratches:



Direction of Travel

H104_0487AC

Causes:

- careless handling of the film during the feeding of the film
- dirty or rough surfaces in the Film Storage Bin
- dirty or rough surfaces on the Feed Tray
- dirty or rough surfaces in the Receive Bin on the processor
- rough edges on the Cassette

Remedies:

- Handle film carefully, both before and after exposure.
- Clean the Feed Tray and check that it is correctly positioned.
- Check for a rough surface on the Feed Tray. If necessary, install a new Feed Tray.
- Check for free movement of all Idling Squeegee and Dryer rollers.
- Teach proper film-handling procedures to technologists.
- Clean the Receive Bin on the processor and check it for damaged surfaces.

Note:

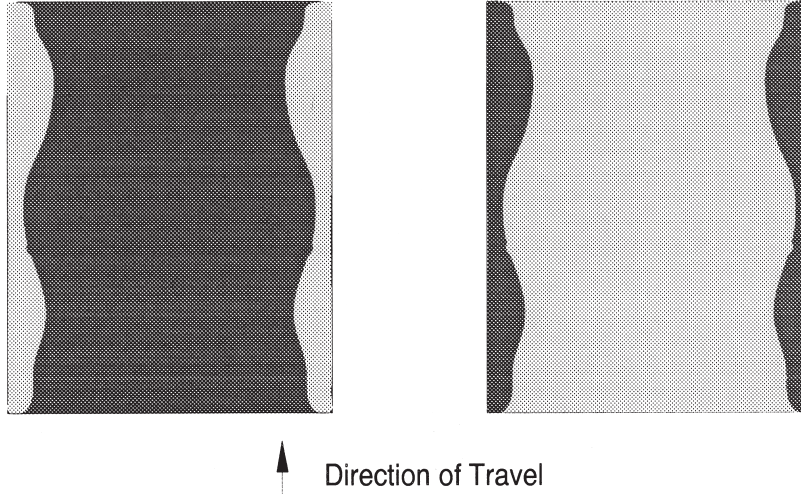
To help eliminate Surface Streaks, always feed single-emulsion film with the emulsion side up.

Wet Pressure Marks

Appearance:

Wet Pressure Marks appear as variations in density which are created from pressure applied to the film emulsion while the film is in the Developer Rack or the Developer/Fixer Crossover.

Wet Pressure:



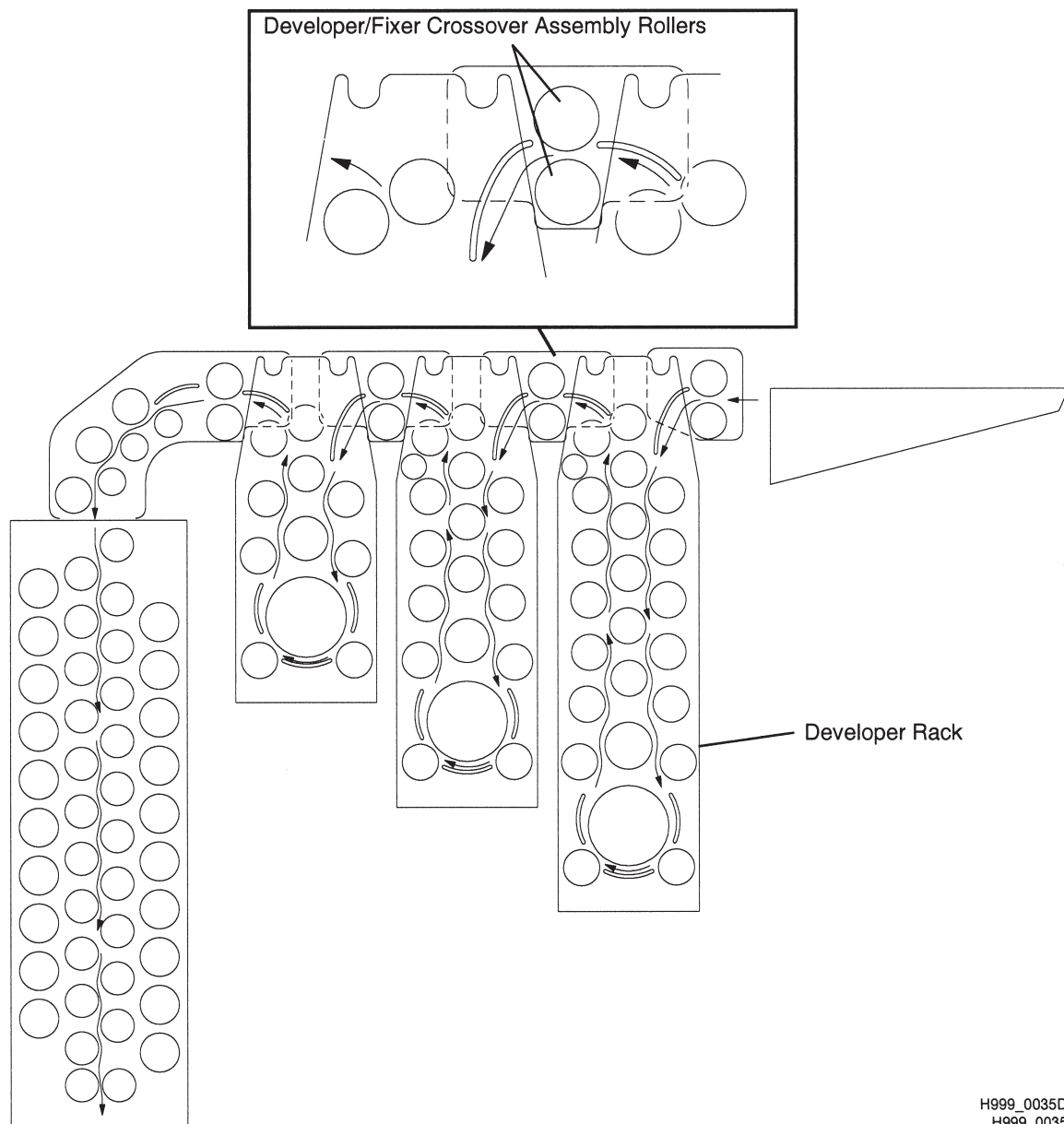
H999_0030BC

Causes:

- rough, blistered, or flawed Rollers
- dirty Rollers in the Developer Rack, Turnaround Assembly, or Developer/Fixer Crossover
- inactive processing solutions
- oversized, warped or bad surface finish on plastic Rollers
- excessive Spring tension at pinch points
- contaminated developer solution
- incorrect replenishment rates
- chemical buildup on Developer Rack Turnaround
- dirty or plugged Filter
- Bad Replenishment Pump

Remedies:

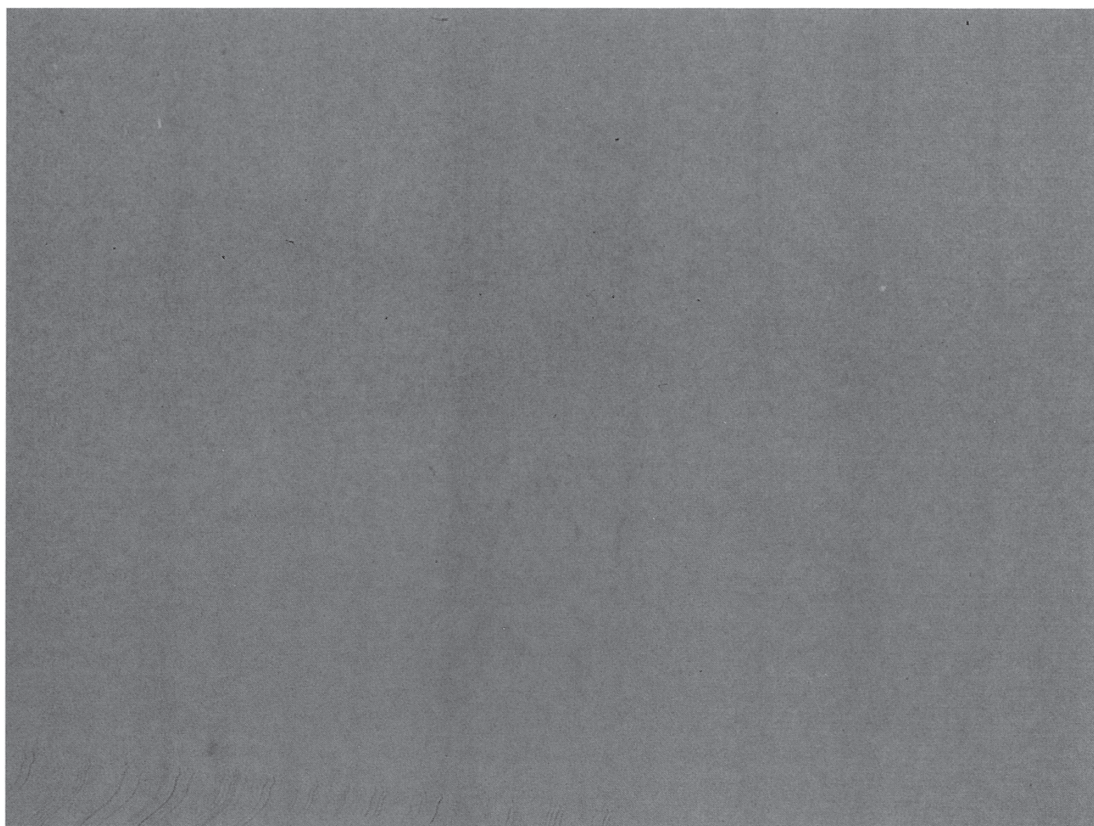
- Inspect the Rollers in the Developer Rack for irregular or rough surfaces. If necessary, install new Rollers.
- Clean the Rollers.
- Check the replenishment rate for the developer solution.
- Mix new developer solution.
- Use the developer temperature setpoint recommended by the manufacturer for your particular combination of film and processing chemicals.



H999_0035DCA
H999_0035DA

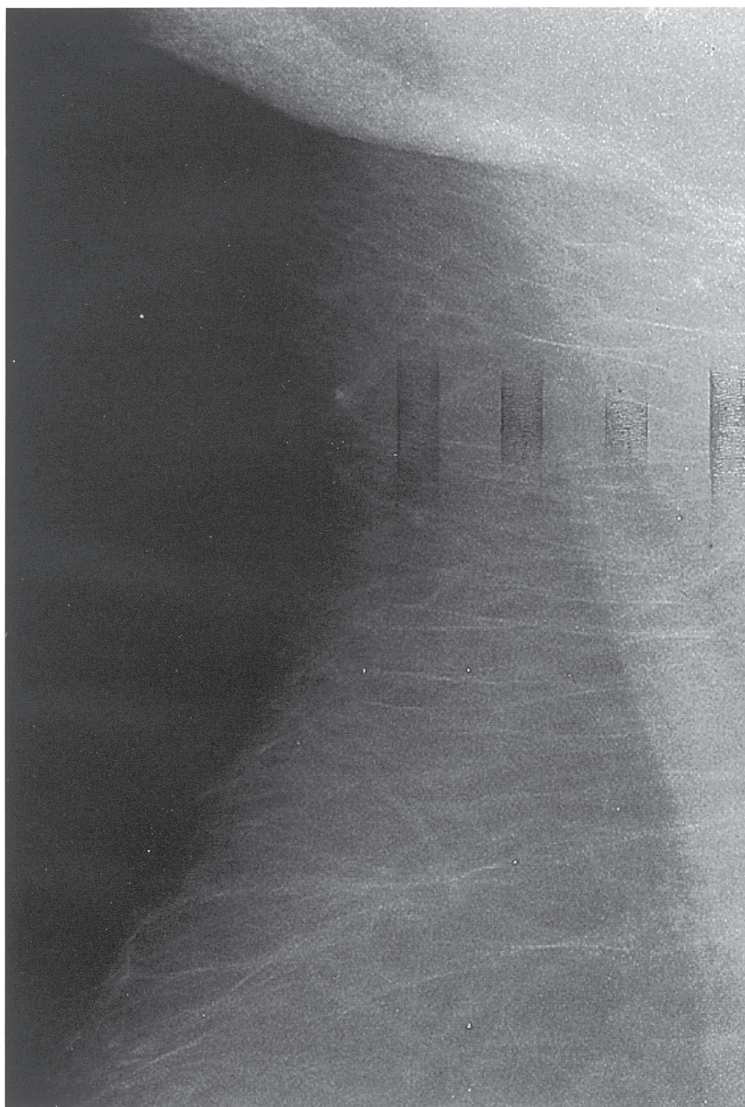
Appendix

Delay Streaks



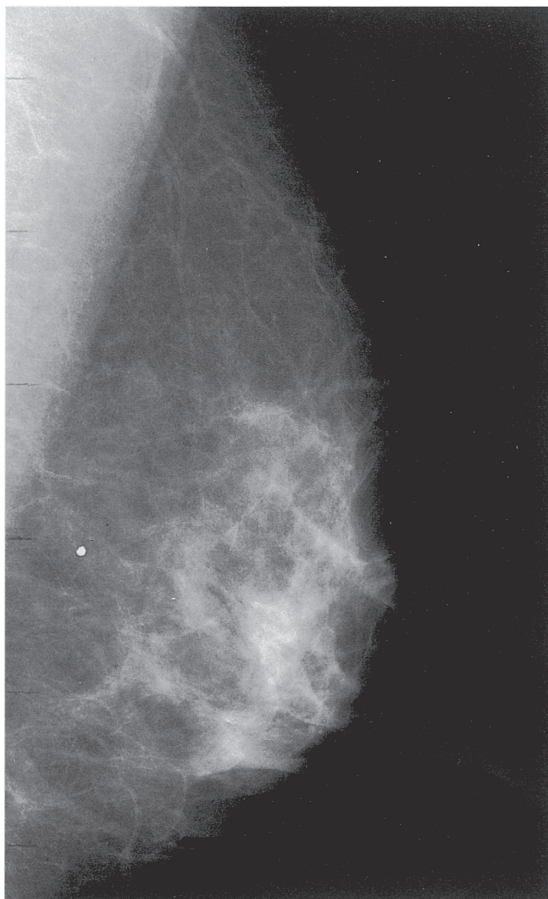
Film Travel Direction

Entrance Roller Marks



Film Travel Direction

Guide Shoe Marks



Plus Density

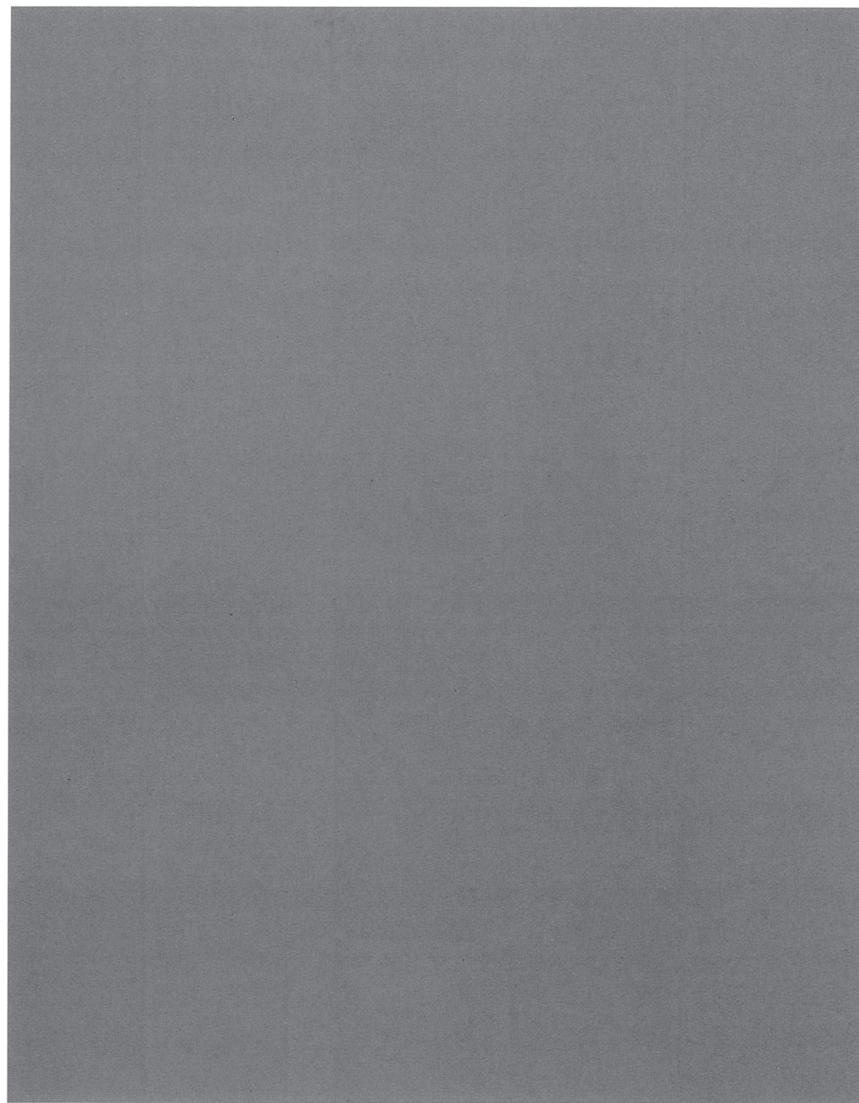


Minus Density



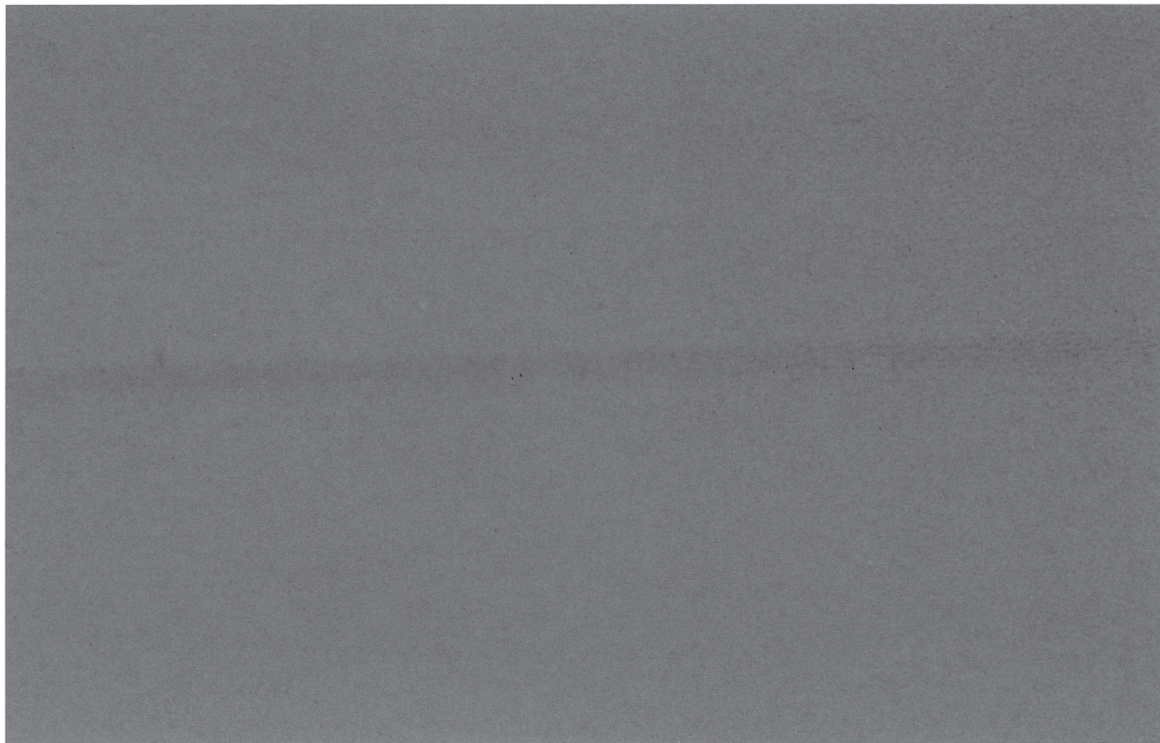
Film Travel Direction

Chatter Lines



Film Travel Direction

Film Hesitation Marks or Stub Lines

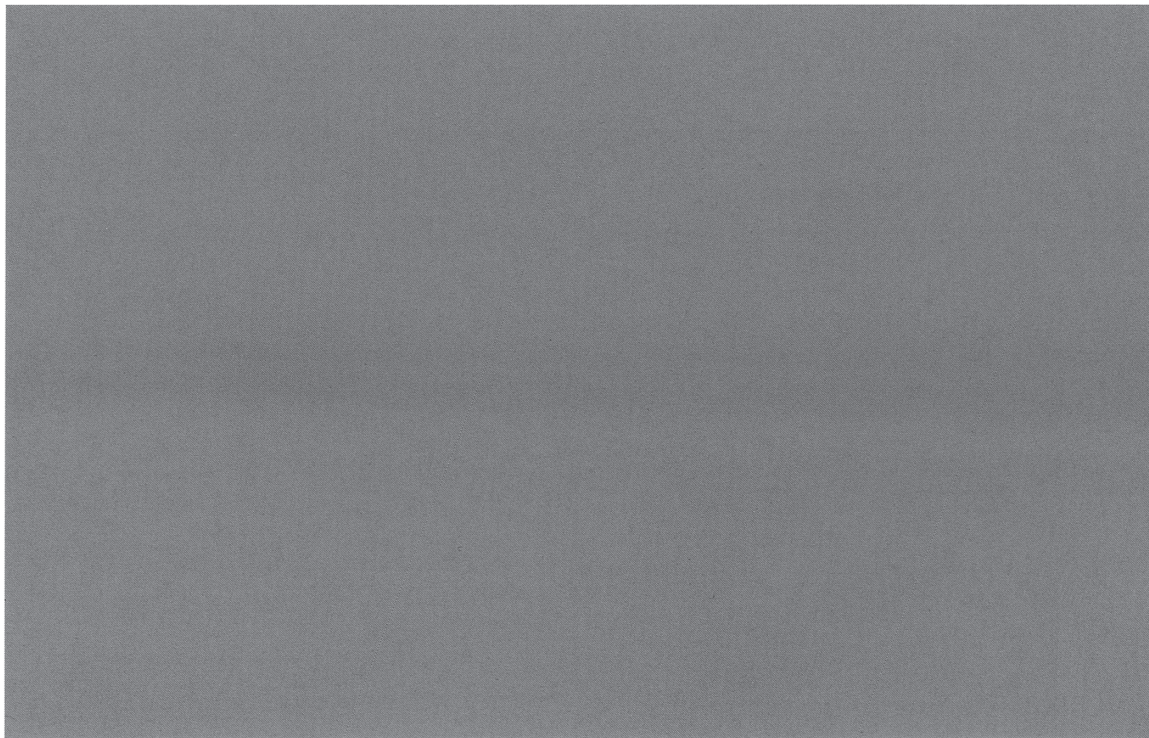


Trailing Edge (Magnified View)



Film Travel Direction

Slap Lines

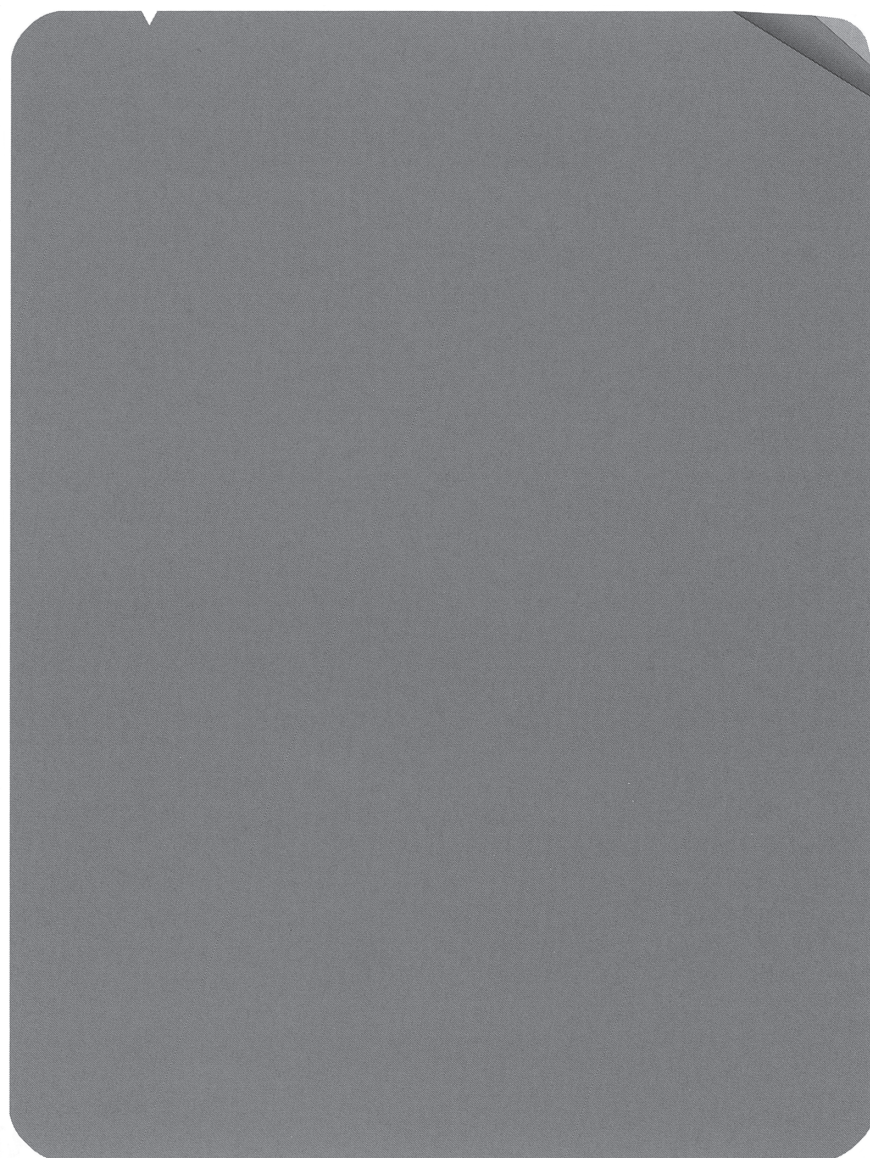


Trailing Edge (Magnified View)



Film Travel Direction

Bent Corners

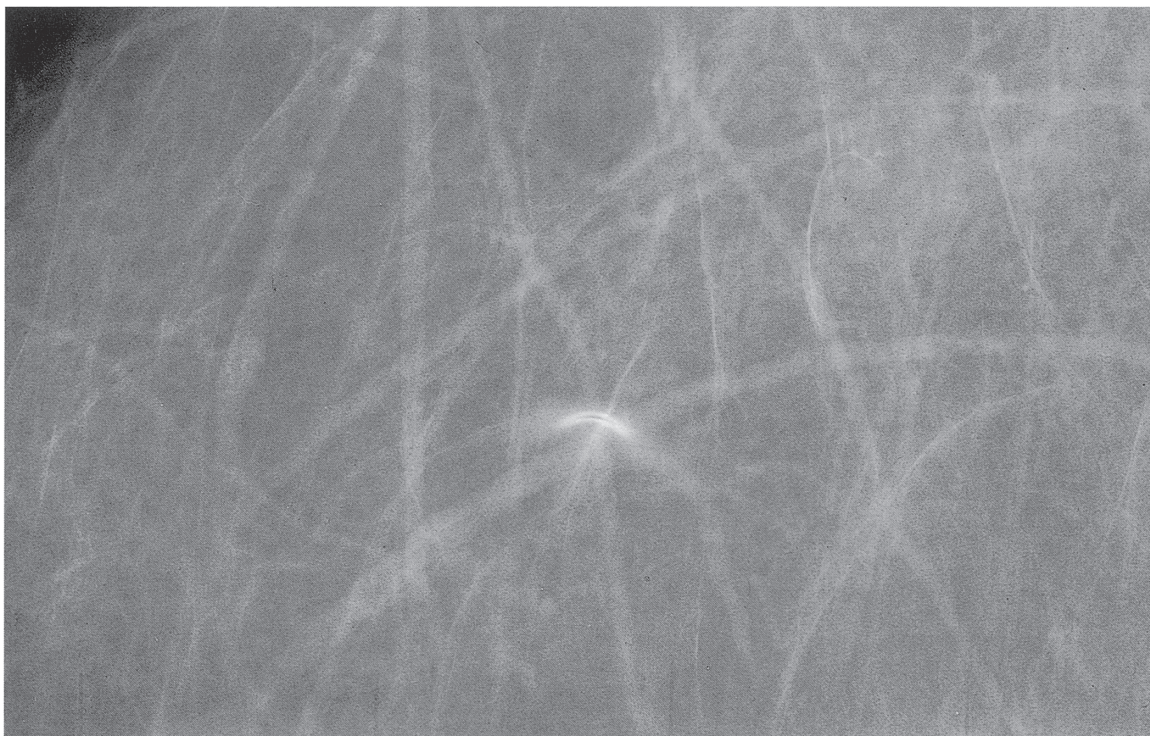


Flame Patterns



Film Travel Direction

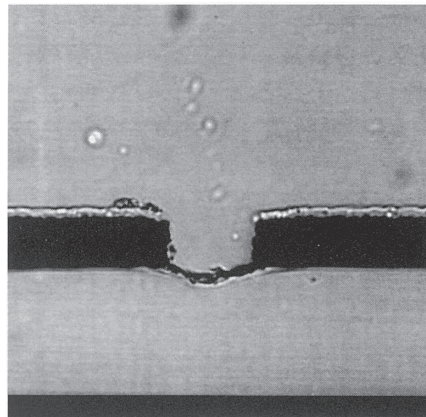
Kink Marks



Pick-Off Marks



Magnification: 155X surface view



Magnification: 850X swollen

Runback Marks



Trailing Edge (Magnified View)

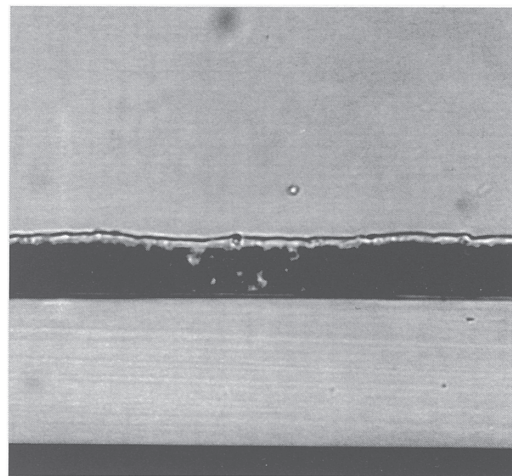


Film Travel Direction

Shadow Images



Magnification: 155X surface view

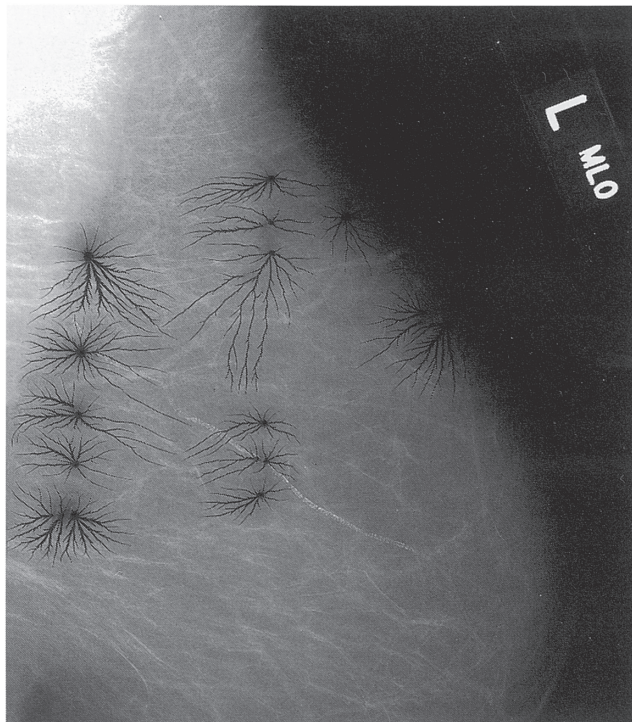


Magnification: 850X swollen

Static Marks

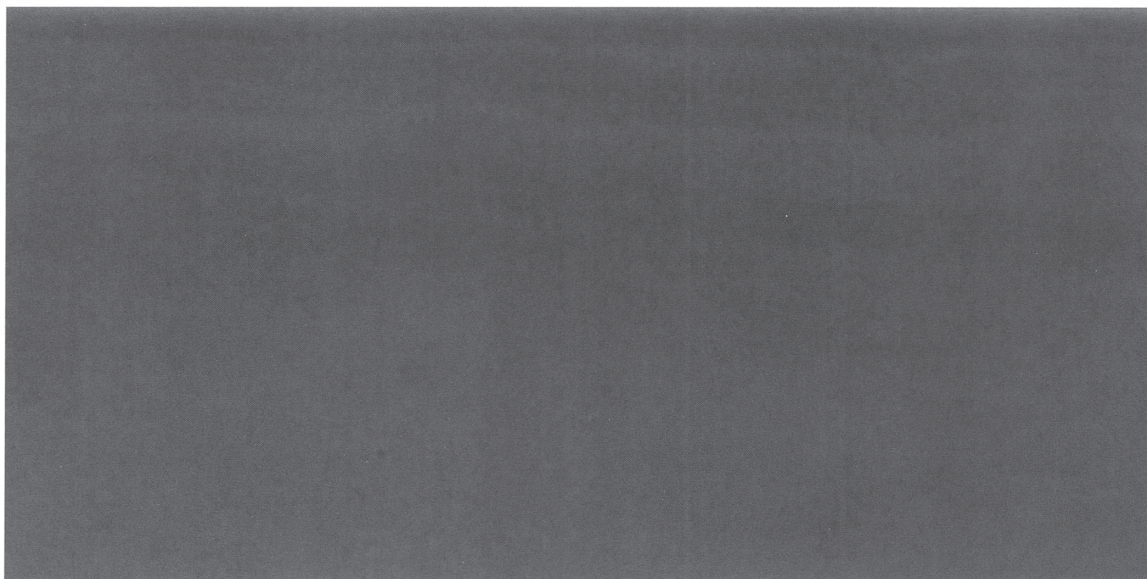


Spot Static

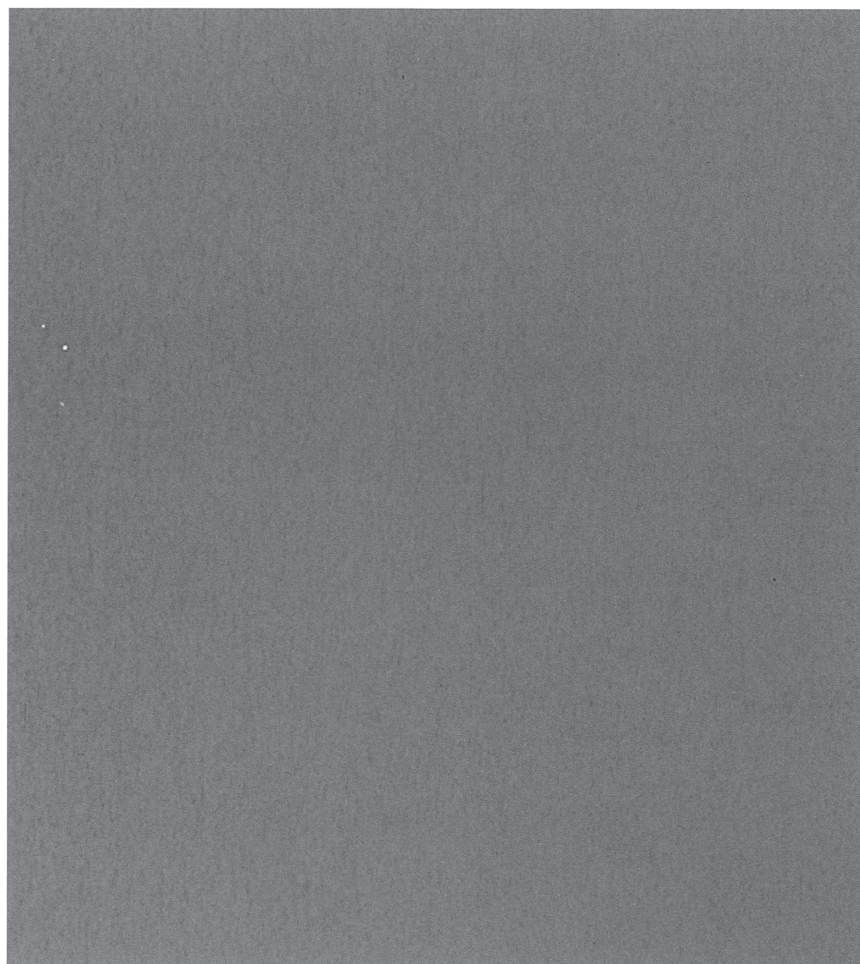


Branch Static

Surface Drying Streaks and Dryer Patterns



Wet Pressure Marks



BLANK

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